



U. S. DEPARTMENT OF AGRICULTURE.

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE GEOLOGICAL SURVEY OF NEW JERSEY, HENRY B.  
KUMMEL, STATE GEOLOGIST; NEW JERSEY AGRICULTURAL EXPERI-  
MENT STATION, JACOB G. LIPMAN, DIRECTOR.

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SOIL SURVEY OF THE CAMDEN AREA,  
NEW JERSEY.

BY

A. L. PATRICK, OF THE U. S. DEPARTMENT OF AGRICULTURE,  
IN CHARGE; C. C. ENGLE, OF THE GEOLOGICAL SURVEY OF  
NEW JERSEY; AND L. L. LEE, OF THE NEW JERSEY  
AGRICULTURAL EXPERIMENT STATION.

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HUGH H. BENNETT, INSPECTOR, SOUTHERN DIVISION.

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[Advance Sheets—Field Operations of the Bureau of Soils, 1915.]



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GOVERNMENT PRINTING OFFICE.  
1917.

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## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF SOILS,  
*Washington, D. C., August 31, 1916.*

SIR: Under the cooperative agreement with the State of New Jersey a soil survey of the Camden area was carried to completion during the field season of 1915.

I have the honor to transmit herewith the manuscript and map covering this work and to recommend their publication as advance sheets of Field Operations of the Bureau of Soils for 1915, as authorized by law.

Respectfully,

MILTON WHITNEY,  
*Chief of Bureau.*

Hon. D. F. HOUSTON,  
*Secretary of Agriculture.*

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### MAP.

Soil map, Camden sheet, New Jersey.

## SOIL SURVEY OF THE CAMDEN AREA, NEW JERSEY.

By AUSTIN L. PATRICK, of the U. S. Department of Agriculture, In Charge; C. C. ENGLE, of the Geological Survey of New Jersey; and L. L. LEE, of the New Jersey Agricultural Experiment Station.—Area Inspected by HUGH H. BENNETT.

### DESCRIPTION OF THE AREA.

The Camden area, comprising nearly all of Camden County, about two-thirds of Gloucester County, about one-sixth of Burlington County, and small parts of Atlantic, Salem, and Cumberland Counties, is situated in the west-central part of southern New Jersey, its northwestern boundary being formed by the Delaware River opposite the city of Philadelphia. The area is approximately rectangular in outline, with a length of 32 miles and a width of 27 miles. It comprises 702 square miles, or 449,280 acres.<sup>1</sup>

Broadly speaking, the topography of the Camden area is level to gently rolling. The more rolling and most steeply sloping areas are encountered near the larger stream valleys. The range in elevation is small, from tide level along the Delaware River and its tributaries to 214 feet above mean tide level on a knoll just northeast of Berlin.

The principal drainage divide is the ridge crossing the area in a general northeast-southwest direction, extending from the vicinity of Hardingsville through Glassboro, Cross Keys, Albion, and West Berlin to the vicinity of Pipers Corner. The crest of this watershed is about 8 to 12 miles wide. It is flat to gently rolling in topography and ranges in elevation from about 130 to 200 feet above sea level. West of this watershed all the drainage enters the Delaware River; on the east the streams are directly tributary to the Atlantic Ocean or Delaware Bay. Subordinate divides reach out between the larger streams, the principal one extending southeasterly from Cross Keys and separating the basin of the Maurice River, tributary to Delaware Bay, from that of Great Egg Harbor River, which is directly tribu-

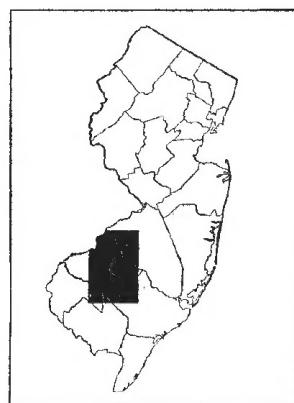


FIG. 1.—Sketch map showing location of the Camden area, New Jersey.

<sup>1</sup> The base map used is by the Geological Survey of New Jersey, and includes all of Atlass sheet No. 31.

tary to the Atlantic Ocean. Plate I shows the topographic and drainage features of the area.

The western slope of the main divide is steeper than that on the east, where the gradient is only 3 to 5 feet to the mile. The distance from the crest of the divide to the Delaware River is only 12 to 15 miles. The steepest part of the slope lies just back of the comparatively smooth country bordering the river. The stream valleys are deepest along the upper part of the slope. In some places the stream channel is 100 feet or more below the general upland level. The streams have cut down to tide level 7 or 8 miles back from the Delaware.

The smooth belt bordering the Delaware River is in the broadest places 8 or 9 miles wide. This lower or tidewater section consists of a nearly level terrace, extending inland along some of the streams for several miles. Inland from the lower or border terrace there are remnants of two successively higher, level terraces. The middle terrace is especially noticeable at Moorestown, where the main street of the town marks the divide between it and the lower terrace.

The streams of the Atlantic Ocean and Delaware Bay drainage systems do not have well-defined channels, but flow through broad, swampy lowlands and have their origin as a rule in low-lying, wet areas. These swampy strips along the streams are known as "cedar brakes" or "pine swamps," depending upon the tree growth.

The history of the region in which the Camden area lies begins in the first half of the seventeenth century. The Swedes planted the first colony in 1637, only to have the Dutch from the New York colony under Gov. Stuyvesant take possession shortly afterwards. The English established a colony on the Delaware River in 1664 and eventually became the owners of southern New Jersey. About 1676, after making a treaty with the Indians, a colony of Quakers settled between Rancocas and Timber Creeks. The territory was claimed and governed by England until the Revolutionary War.

Many of the descendants of the early settlers live in the region to-day, although through the immigration station at Gloucester in Camden County there has been a steady inflow of foreigners. According to the last census, there are 20,838 foreign-born white persons in Camden County alone. These are mostly from Germany, England, Italy, Ireland, and Russia. In Camden County the density of the rural population is 131 persons per square mile, as compared with 98.6 persons per square mile in Gloucester County and 66.2 persons per square mile in Burlington County.

Among the many towns in the area the only one with a population of over 10,000 in 1910 is the manufacturing city of Camden, with 94,538 inhabitants. Gloucester, the next most important city, had a

population of 9,462 in 1910. Moorestown, Haddonfield, Merchantville, and Woodbury are other towns of considerable importance, located within 15 or 20 miles of Camden and Philadelphia, in which cities many of the residents are employed. Pitman is a summer resort of considerable importance, and Mount Holly, Glassboro, Hammonton, Williamstown, Elmer, and Medford are prominent agricultural, shipping, and manufacturing centers. Canneries are located at Mount Holly, Williamstown, Elmer, Glassboro, and Camden. These towns, together with Philadelphia, consume the bulk of the salable crops produced, although considerable farm produce is shipped to New York, 90 miles to the north, and to many other points.

There are few parts of the United States where better transportation facilities are available than in the Camden area. Lines of the Pennsylvania Railroad, the Philadelphia & Reading Railway, and the Central Railroad of New Jersey traverse nearly all parts of the area. Camden, which is connected with Philadelphia by ferry lines, is the transportation center from which several steam and electric lines radiate. In addition, ocean liners pass up the Delaware River to Philadelphia and Camden, and the tidewater streams furnish cheap water transportation for nonperishable freight, such as manure, coal, and lumber. Excellent wagon roads are maintained in all the developed agricultural communities.

#### CLIMATE.

Owing to the modifying influence of the warm currents in the Atlantic Ocean and the tempering effect of large bodies of water on all sides, the climate of the region in which the Camden area lies is less severe than the latitude would suggest. While the winters are cold, 31.4° F. being the seasonal mean recorded at Moorestown, there are as a rule no very sudden extremes in the weather. The lowest temperature recorded is —16° F. The rather high humidity, however, makes the cold more penetrating, rendering also the heat of the summer months more oppressive. The mean temperature for the spring season is 49.7° F. and for the summer 72.5° F. The temperature seldom reaches 100° F. For the fall an average temperature of 54.3° F. is reported. The mean annual temperature is recorded as 52° F.

The mean annual precipitation is 45.89 inches. The rainfall for the driest year on record is 35.90 inches, and for the wettest year 65.21 inches. Snow does not form a considerable percentage of the annual precipitation, though the average fall at Moorestown is 28.3 inches. Sufficient rain falls in most years to supply the needs of

growing crops. The year of 1914, however, for instance, was exceptionally dry and crops suffered. In 1915 there was such an excess of rain as to injure crops.

The average growing season is about 6 months in duration. The Moorestown Weather Bureau station reports the average date of the last killing frost in spring as April 23 and that of the first in the fall as October 20. Frost has occurred, however, as late in the spring as May 15 and as early in the fall as September 22.

The following tables give the normal monthly, seasonal, and annual temperature and precipitation as recorded at the Weather Bureau stations at Moorestown, situated in the north-central part of the Camden area, and at Bridgeton, in Cumberland County, south of the limits of the area surveyed. There is no pronounced difference in the records at these two stations, but they are both inserted as showing the range in climatic conditions throughout the area.

*Normal monthly, seasonal, and annual temperature and precipitation at Moorestown, Burlington County.*

Month.	Temperature.			Precipitation.			
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.	Snow, average depth.
December.....	33.2	76	- 9	3.55	2.20	7.34	5.6
January.....	30.1	73	-16	3.50	4.80	2.95	8.0
February.....	30.8	72	-13	3.60	0.94	6.45	8.3
Winter.....	31.4	76	-16	10.65	7.94	16.74	21.9
March.....	38.3	86	2	3.82	3.97	4.22	4.7
April.....	49.9	94	21	3.14	5.12	3.63	0.6
May.....	61.0	97	31	4.07	2.64	2.45	0
Spring.....	49.7	97	2	11.03	11.73	10.30	5.3
June.....	70.2	99	41	3.83	5.05	7.30	0
July.....	74.8	102	50	4.63	2.94	7.05	0
August.....	72.5	101	48	4.81	0.63	8.44	0
Summer.....	72.5	102	41	13.27	8.62	22.79	0
September.....	65.8	103	32	3.82	0.47	5.29	0
October.....	54.2	90	25	3.69	4.27	7.59	0
November.....	42.8	78	10	3.43	2.87	2.50	1.1
Fall.....	54.3	103	10	10.94	7.61	15.38	1.1
Year.....	52.0	103	16	45.89	35.90	65.21	28.3

*Normal monthly, seasonal, and annual temperature and precipitation at Bridgeton, Cumberland County.*

Month.	Temperature.			Precipitation.		
	Mean.	Absolute maximum.	Absolute minimum.	Mean.	Total amount for the driest year.	Total amount for the wettest year.
December.....	36.8	71	0	3.70	3.38	0.67
January.....	34.0	74	-7	3.44	3.79	4.03
February.....	34.2	72	-7	4.25	2.46	2.70
Winter.....	35.0	74	-7	11.48	9.63	7.40
March.....	42.3	85	10	4.42	2.24	6.49
April.....	52.7	93	23	3.49	2.26	4.96
May.....	64.6	97	31	4.12	3.58	6.60
Spring.....	53.2	97	10	12.03	8.08	18.05
June.....	73.3	101	43	3.51	1.56	4.48
July.....	77.2	104	50	4.54	2.05	7.66
August.....	75.6	102	49	4.46	5.30	3.29
Summer.....	75.4	104	43	12.51	8.91	16.43
September.....	68.8	99	35	3.56	.81	3.97
October.....	57.0	90	28	3.83	2.91	3.91
November.....	45.9	78	15	2.96	3.89	7.99
Fall.....	57.2	99	15	10.35	7.41	15.87
Year.....	55.2	104	-7	46.37	34.03	56.75

#### AGRICULTURE.

Little definite information is available concerning the early agricultural development in the Camden area. The early Swedish and Dutch settlements were merely trading posts. When New Jersey became a British Colony (1664), more attention was given to farming. Corn, buckwheat, wheat, and tobacco were the principal crops grown, and cattle and hogs were raised on the open range. Stimulated by the growth of near-by cities the agriculture developed with comparative rapidity. General farming, coupled with dairying, prevailed for many years, but in turn was largely supplanted by the present-day system of farming, in which the dairy industry is mainly confined to those farms on which there is a large percentage of land which can be utilized only for pasture.

The present types of farming are trucking alone and a combination of trucking and general farming. Locally the production of brier berries, cranberries, peaches, and apples is important. The general farm crops are grown primarily for stock feed. Green manure crops are frequently introduced into the rotation as a source of

organic matter. Dairying is still important in some sections of the area, but seems to be decreasing. Most farmers keep one or more cows, and raise a few hogs to provide meat supplies for home use, but otherwise the live-stock industries are of little importance. Poultry raising is a growing interest, especially in the vicinity of Hammonton, Newfield, Williamstown, and Elmer.

Of the crops grown for sale Irish potatoes, sweet potatoes, tomatoes, peppers, asparagus, and cantaloupes are the most important, ranking in the order named. Chief among the minor income crops are sweet corn, eggplant, cucumbers, watermelons, cabbage (early and late), beans, peas, and onions. These truck crops collectively are very important in the agriculture of the area. Corn, hay and forage, and rye are the principal general farm crops. The sale of these field crops is almost entirely local. Only a very small percentage of the production is marketed, by far the larger part being fed on the farm to the work horses, cows, hogs, and poultry.

As Camden County, which lies almost entirely within the area surveyed, is fairly typical of the area as a whole in soil and topography, the census statistics for the county, which forms about one-third of the area surveyed, will give a general idea of the type of agriculture and state of development in this part of the State.

The value of the crop production in Camden County in 1909 is given by the census as follows: Vegetables, \$780,274; fruit, including small fruits, nuts, and grapes, \$327,315; cereals, \$224,416; and hay and forage, \$190,240. The value of the year's production of dairy products is reported as \$174,544, and that of animals sold or slaughtered as \$106,721.

Vegetables in 1909 occupied 11,544 acres in Camden County, with Irish potatoes and sweet potatoes constituting about 40 per cent of the total acreage in vegetables. Cereals occupied 9,569 acres, hay and forage crops 7,545 acres, and small fruits 2,946 acres. The census reported 46,098 peach trees, 20,606 apple trees, 71,083 pear trees, and 104,300 grapevines in the county.

The character of soil and topography has had a marked influence from place to place upon the crops grown, the agricultural industries, methods of production, and the size of farms. For instance, in the vicinity of Thorofare, Almonesson, and other places where the soil is well drained, light in texture, and otherwise well suited, truck crops are grown chiefly. Where the soil is heavier, as in the vicinity of Moorestown, the growing of the general farm crops together with vegetables, such as potatoes and medium-late tomatoes for canning, is the principal interest. The low, swampy tracts (Hyde loamy sand) in the eastern part of the area and the low Tidal marsh land along the Delaware River and its tributaries are mostly unutilized, except locally for growing cranberries and pasturing stock.

The broad stretch of white, sandy land in the east-central part of the area, known locally as the "sand country," remains largely covered with timber, much of it of a scrubby growth of little value.

Light teams and implements are employed on the deep, sandy soils. Since the crops grown on these coarse-textured soils are mostly vegetables, requiring intensive treatment, farms are smaller than in the areas of heavier soils, where the general farm crops are relatively more important. Twenty to forty acres constitutes the usual area under individual cultivation here, as compared with 100 to 160 acres in the areas of heavier soils.

There are few sections of the United States, if any, where the soils are more generally used in accordance with their particular crop adaptations than in the Camden area. The favorable location with respect to large markets and the excellent transportation facilities are factors which have in large part made possible the general practice of using the soils for those crops to which they are naturally best suited. The sandy soils, including the Sassafras sands, the Collington sand and sandy loam, deep phase, and the Norfolk fine sand, are peculiarly associated with the production of early vegetables, such as tomatoes, asparagus, sweet potatoes, cantaloupes, beans, peas, sweet corn, and eggplant. Brier berries also thrive on these soils. The sandy loams are generally used for medium to late vegetables, such as Irish potatoes, tomatoes for canning, cabbage, and peppers, as well as for beans, peas, and sweet corn, in conjunction with the production of some general farm crops, chiefly corn, clover, and timothy. Peaches, apples, and pears are also produced largely on the sandy loams. The loams of the Sassafras, Collington, Elkton, Portsmouth, and Keansburg series, together with the fine sandy loams of the Collington and Sassafras, are used chiefly for general farming, with Irish potatoes grown as a specialized crop. Some dairying is carried on locally on the sandy loams and loams. Poultry raising is largely confined to the Sassafras sandy loam. Cranberries are grown only on the Hyde loamy sand.

Figures 2 and 3 show, respectively, the general distribution of the soils of the area by texture and the prevailing types of agriculture and proportion of forested land. A comparison of these illustrations shows in a general way the relation of the type of agriculture to the texture of the soils.

In preparing land for planting, breaking is usually done in the spring with 2-horse plows, but 1-horse turning plows are used in some sections of the area on the smaller farms. The land is broken to an average depth of 6 or 8 inches and is subsequently run over once or twice with smoothing harrows, and frequently in case of the heavier soils with other harrows. The land is commonly disked after the removal of such crops as potatoes and tomatoes, in preparation,

for timothy, clover or a small grain. Most crops are planted in furrows and are cultivated practically level, the cultivation given being shallow and at frequent intervals. The common practice is to cultivate after every rain. Sweet potatoes, and often Irish potatoes, are laid by on ridges. Asparagus is grown on high ridges. Light

1-horse cultivators are in general use for the cultivation of crops.

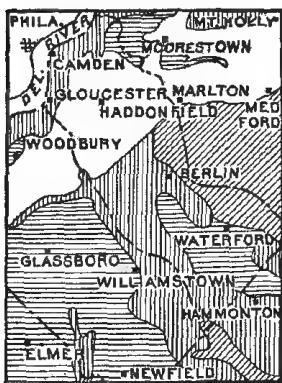
Irish potatoes are put in with 2-horse planters as soon as danger of frost is over. The seed is obtained mostly from Maine, the principal variety being the Irish Cobbler. In the case of sweet potatoes, slips from hotbeds are trans-

planted by hand about the middle of May. Irish potatoes are harvested with either 3 or 4 horse diggers, the draft used depending upon the texture of the soil. Plate II, figure 1, shows the method of harvesting potatoes on the Sassafras loam. Sweet potatoes are dug or plowed out with a special plow. Tomatoes for the early market are

FIG. 2.—General distribution of soils by texture.

planted by hand about the last of April. Those for canning are transplanted 2 or 3 weeks later. The most common variety of early tomatoes grown is the Starks Earliana; the Stone is the most popular variety for canning purposes. Peppers are transplanted by hand from hotbeds about May 1. The principal varieties grown are White Cap and Ruby King. Cantaloupes and cucumbers are planted in May. The Fordhook is one of the common varieties of cantaloupes grown.

Apples, peaches, and pears are cultivated until about the middle of July, when a cover crop of crimson clover, vetch or cowpeas is



LEGEND  
Mainly fine sandy loams and loams (Sassafras and Collington)  
Mainly sandy loams (Sassafras and Collington)  
Mainly sands (Sassafras and Collington)  
Mainly sands (Lakewood and Hyde)



LEGEND  
Mainly truck crops.  
About 10 per cent of area woodland.  
Mainly medium to late truck crops with general farming.  
About 30 per cent of area woodland.  
Mainly medium to late truck crops with general farming.  
About 60 per cent of area woodland.  
Mainly fruit, medium truck crops.  
About 70 per cent of area woodland.  
Very little agriculture.  
About 90 per cent of area woodland.

FIG. 3.—Prevailing types of agriculture and proportion of forested land.

sown, to be plowed under in the spring. Crops requiring cultivation are usually grown between the trees during the first few years after setting. The trees are usually sprayed and pruned regularly. The principal varieties of apples grown in the area are the Williams Early Red, Wealthy, Grimes, Stayman Winesap, Rome, and Yellow Transparent; of peaches, the Elberta, Belle of Georgia, Carman, Champion, and Mountain Rose; and of pears, the Kieffer and Bartlett.

Practically all the farmers use both commercial fertilizer and animal manure for truck crops, usually applying the two to the same field. The general farm crops are not commonly fertilized, with the exception of a top-dressing of manure on sod. The fertilizer mixture usually analyzes about 4-8-10<sup>1</sup> for all crops except sweet potatoes, for which a 2-8-10 preparation is commonly used. The common application of fertilizer is 1,000 pounds per acre, although many farmers use less and some more. The fertilizer is generally applied in the row at about the time of planting, being covered to a shallow depth. The manure used, which is largely shipped from Philadelphia, Camden, Wilmington, and New York by rail or boat, is applied ordinarily at the rate of 8 or 10 tons to the acre, in the fall before the land is plowed. The census reports the expenditure in 1909 for fertilizers in Camden County as \$236 for each of the 943 farms reporting.

Most of the farm labor is performed by the farmers and their families. The extra laborers required during the harvest season are mainly foreigners obtained from the near-by cities. The regular hands are paid monthly wages, while the "harvest help" is paid according to the work performed. Many women and children work in the harvest fields. In the 1910 census two-thirds of the farmers report expenditure for labor, the outlay per farm reported averaging \$500.

The average size of farms in Camden County is 52.2 acres, of which 40.3 acres are improved. The census reports the total number of farms as 1,244, of which 69.5 per cent are operated by owners, 28.6 per cent by tenants, and 1.9 per cent by managers. Both the cash and share systems are practiced. Under the first-named system the operator pays a cash rental, usually equal to 5 or 6 per cent of the value of the farm, the owner bearing the repair, tax, and insurance expenses only.

There are a number of different share systems used. Under the most common one the landlord pays for the fertilizer, manure, and repairs on buildings, taxes, and insurance (except on the tenant's own property), one-half the cost of the spray materials and seed used, and one-half the cost of marketing, including commission, basket,

<sup>1</sup> Containing 4 per cent nitrogen, 8 per cent phosphoric acid, and 10 per cent potash.

and ferry charges. The tenant feeds all the stock kept on the farm from the undivided hay and grain, and owner and tenant each receive one-half of all returns from sales. Another popular arrangement is the one known locally as the trucker system. This is confined largely to small parts of farms of which the remainder is worked by either the owner or cash tenants. The owner furnishes all the requisites except labor and usually selects the crop to be planted. The operator receives one-third of the crop.

A large proportion of the land in the Camden area, especially near the main transportation routes, has an added value on account of suburban influences. The value of farm land is influenced to a marked degree by nearness to good roads. In many sections of the area four horses are required to draw a loaded wagon to the improved highway, after which two are sufficient to haul it to market. The census of 1910 reports the value of the average farm in Camden County as \$6,820, of which 57.4 per cent is represented by the land, 30.3 per cent by buildings, 4.9 per cent by implements, and 7.4 per cent by domestic animals. The average assessed value of farm land is reported as \$74.99 an acre in 1910.

#### SOILS.

The Camden area lies wholly within the Coastal Plain and its soils are derived from beds of unconsolidated sand, sandy clay, gravel, greensand or "marl," and "marly clay." These beds are composed of materials which were transported from older land areas and deposited or brought to rest in part under marine conditions. The older deposits, the Cretaceous<sup>1</sup> in the northern part of the area and the Miocene in the southern part, with their included members or subordinate beds, dip toward the southeast with a fall of 25 to 45 feet per mile, so that the older strata sink beneath the more recently placed beds from north to south. Later Pleistocene deposits, including the Bridgeton, Pensauken, and Cape May members, were spread out over the Cretaceous and Miocene beds. Only remnants of these surficial Pleistocene formations of gravel, sand, and clay occur over the area, much of the material having been removed by erosion.

The Cretaceous formations, occurring in the northern part of the area, carry in several subordinate beds, particularly in the Marshalltown, Navesink, Hornerstown, and Manasquan beds, large quantities of greensand (greensand "marl") or glauconitic material (a hydrous silicate of potassium and iron). These formations give rise to the Collington and Shrewsbury series of soils. Some of the Cretaceous

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<sup>1</sup> The treatment of geology in this report is based upon the work of the Geological Survey of New Jersey.

beds in the Camden area, however, as well as the later surficial Pleistocene deposits, are not glauconitic. Those soils, developed in general in the northern part of the area, which are altogether lacking in, or are very low in, greensand material, are classed in the Sassafras series. The Elkton loam is closely associated with the Sassafras soils. It occurs in low or imperfectly drained areas, as does also the Keansburg loam.

The surface soils of the Collington series are characteristically brown in color and the subsoils are greenish brown to dark green. Where the texture is clay the material is stiff and sticky when wet. Both surface soil and subsoil contain glauconitic material or greensand. The topography of the Collington series is undulating to gently rolling and the soils, as a rule, are well drained. In this survey the Collington gravelly loam, sand, sandy loam, fine sandy loam, clay, and loam are recognized.

The Shrewsbury series includes types with gray to grayish-brown or light-brown surface soils, and rather plastic, heavy clay or sandy clay subsoils, mottled gray and yellow or reddish, bluish gray, and greenish yellow. Characteristically, in the lower few inches of the 2-foot section, the texture is lighter than in the overlying subsoil with a wide range in color from greenish yellow through orange yellow to red. The Shrewsbury soils are imperfectly drained, occupying relatively low flats and depressions. They are derived from the marl beds of the Cretaceous and in some respects this series holds a relation to the Collington comparable to that existing between the Elkton and Sassafras series. The Shrewsbury sandy loam is mapped in this survey.

The Elkton soils are gray or ashen gray in the surface portion and light gray, mottled with yellow, in the subsoil. The Elkton loam is the only type of the series recognized in this survey.

The surface soils of the Keansburg series are dark gray to black, with mottled bright-yellow, bluish-gray, brown, and sometimes rusty-red subsoils. Greensand is present in the subsoil, at least in places. The material apparently has a relation to the Collington material similar to that which the Portsmouth series bears to the Norfolk. In the Camden area the Keansburg series is represented by the loam type.

South of the Cretaceous belt, whose southern border forms an irregular line across the area between Barnsboro on the west and Medford on the east, the Miocene formations are developed. Here the Sassafras and Lakewood soils predominate in the well-drained situations, and the Hyde and Portsmouth series in the low, wet areas. The Kirkwood formation, representing the older part of the Miocene deposits, gives rise to the Norfolk fine sand and a large part of the

Sassafras fine sand and fine sandy loam. The Cohansey division of the Miocene gives rise to the Lakewood series and the coarser textured members of the Sassafras series, as well as to most of the Hyde and Portsmouth soils. The gravelly soils here, as in the northern part of the area, are associated with the recent surficial Pleistocene deposits.

The Sassafras series is characterized by the brown color and mellow to loose structure of the surface soils and by the reddish-yellow color and friable structure of the subsoil. Material more friable and coarser than that of the upper subsoil, such as gravel and sand, is characteristically encountered in the lower subsoil. The substratum is usually porous, favoring excellent underdrainage. The Sassafras soils occur at all elevations from near sea level to the highest divides in the area. Nine types are recognized, the gravelly sandy loam, coarse sand, sand, loamy sand, fine sand, coarse sandy loam, sandy loam, fine sandy loam, and loam.

The Lakewood series includes light-gray to nearly white surface soils, with yellowish or orange-colored subsoils. The soils of this series are loose and leachy, consisting very largely of quartz sand, and drainage is excessive. The series is represented in this survey by the sand type.

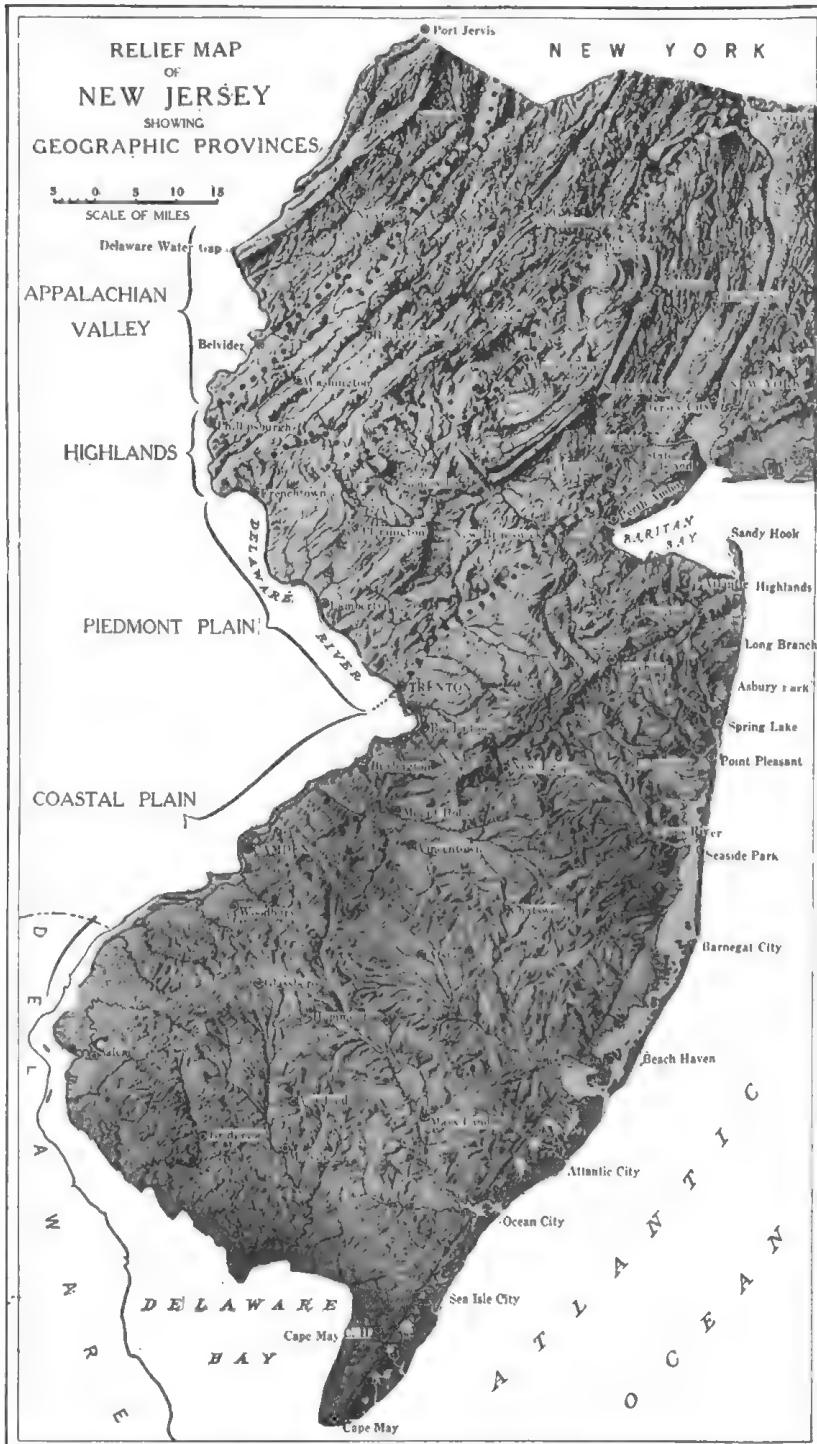
The Hyde soils are characterized by their poor drainage, generally black color through the 3-foot section, and the high content of dark-colored vegetable matter. They occur in relatively low situations. They differ from the Portsmouth types in that they are dark colored in both surface soil and subsoil, the Portsmouth being black in the surface soil and lighter colored in the subsoil. The Hyde loamy sand is mapped in the Camden area.

The types of the Portsmouth series are dark gray to black in the surface soil and light gray or nearly white in the subsoil, with abundant mottlings of yellow. The soil runs high in content of dark-colored organic matter. The Portsmouth series is developed in low situations where drainage is poor. The sandy loam and loam types are identified in this survey.

The Norfolk series is characterized by the grayish color of the surface soils and by the yellow color and friable structure of the subsoils. The Norfolk types occupy level to slightly rolling country, and have good to excessive drainage, the degree of thoroughness varying with the soil texture. Only the fine sand type of this series is mapped in the Camden area.

The alluvial soils of the area, classed in the Freneau series, consist of wash from the local uplands. Most of the alluvium has been washed from the Collington and Sassafras soils.

The Freneau soils are characterized by the dark-brown to mottled brown and rusty-brown color of the surface material, and by the mottled reddish, rusty-brown, yellowish, greenish, and bluish color of the



GEOGRAPHIC PROVINCES OF NEW JERSEY.

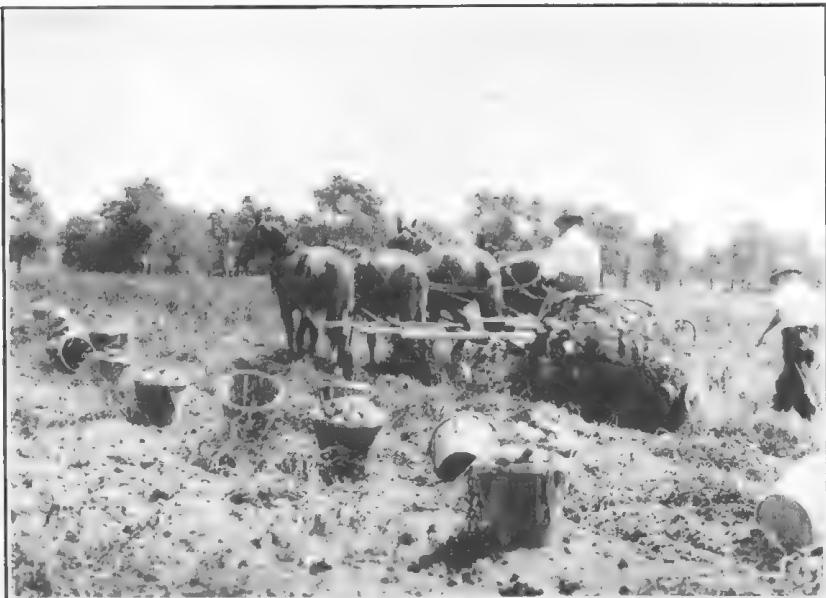


FIG. 1.—HARVESTING POTATOES ON SASSAFRAS LOAM, NEAR MOORESTOWN.

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FIG. 2.—PEACHES ON SASSAFRAS GRAVELLY SANDY LOAM, NEAR HAMMONTON.

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subsoil. In places the subsoil is dark green. These soils, occupying the first bottoms of streams, are mostly poorly drained. In the Camden area the Freneau loam is recognized.

The white sands of the Lakewood series and the areas of black, swampy sand are for the most part restricted to the Atlantic slope of the principal divide of the area, but most of the other soils are widely distributed in occurrence, with the exception of the Collington series, which is confined to the northern part of the area. The position of occurrence has had much effect in developing the present characteristics of the soils, chiefly through the influence of drainage upon the color of the material and the degree of oxidation. The dark-colored soils are developed in the poorly drained, low situations, and the brown and light-colored types where drainage is good.

The various soils are grouped into series on the basis of origin of the material, color, and structural and drainage characteristics. The types, the units of soil classification, are separated within the series on the basis of texture of the material and the content of gravel. In addition to the 24 soil types included in the 10 series identified in the Camden area, two miscellaneous classifications are recognized. Riverwash includes coarse-textured deposits of the Delaware River, developed as an island. Tidal marsh comprises areas subject to tidal inundation, but for the most part capable of being reclaimed for agricultural uses. Reclaimed tidal-marsh areas are shown on the map by symbol.

In the following pages of this report the various soil types are described in detail and treated in their relation to agriculture. The distribution of the soils is shown on the map accompanying this report, and in the table below the actual and relative extent of each type is given:

*Areas of different soils.*

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Sassafras sandy loam.....	82,112		Shrewsbury sandy loam.....	10,624	2.4
Imperfectly drained phase.....	3,581	19.1	Keansburg loam.....	8,064	1.8
Sassafras sand.....	63,552	14.1	Norfolk fine sand.....	6,528	1.4
Hyde loamy sand.....	41,216	9.2	Tidal marsh.....	6,336	
Lakewood sand.....	36,864	8.2	Reclaimed.....	128	1.4
Sassafras gravelly sandy loam.....	31,616	7.0	Sassafras coarse sand.....	5,568	1.2
Portsmouth sandy loam.....	26,496	5.9	Sassafras fine sandy loam.....	5,504	1.2
Collington fine sandy loam.....	24,256	5.4	Collington loam.....	3,426	.8
Sassafras loamy sand.....	22,720	5.0	Elkton loam.....	3,008	.7
Freneau loam.....	12,928	2.9	Sassafras fine sand.....	2,432	.5
Collington sandy loam.....	3,520		Collington gravelly loam.....	2,304	.5
Deep phase.....	9,152	2.8	Portsmouth loam.....	2,176	.5
Sassafras loam.....	12,416	2.8	Collington clay.....	704	.2
Collington sand.....	11,072	2.5	Riverwash.....	256	.1
Sassafras coarse sandy loam.....	10,688	2.4	Total.....	449,280	

## SASSAFRAS GRAVELLY SANDY LOAM.

The Sassafras gravelly sandy loam consists of a light grayish brown loamy sand, underlain at about 6 to 10 inches by reddish-yellow to dull-red friable sandy clay, containing more coarse material and having a looser structure in the lower part of the 3-foot section. Gravel is scattered over the surface and distributed abundantly throughout the soil section. Frequently the subsoil, at least in the upper part, is less gravelly than the surface soil. The gravel consists for the most part of rounded white quartz particles varying in diameter from less than one-half inch to 2 inches. Here and there are embedded subangular gravel and stones from sedimentary and crystalline rocks. On the higher knobs varying quantities of red fragments of iron-crust material are mixed with the gravel.

The Sassafras gravelly sandy loam has its greatest development in the southern part of the area, important bodies occurring southeast of Elmer, near Glassboro, Barnsboro, Williamstown, Cross Keys, and Hammonton. The type occupies hillocks, ridges, and stream slopes. In the southern part of the survey large areas are encountered where the topography is undulating to gently rolling. The drainage is good, owing to the content of coarse material in the surface soil and subsoil as well as to the position occupied.

The type is an important one in the agriculture of the area, approximately 70 per cent of it being cultivated. The uncleared areas are forested chiefly with white, red, and black oak, chestnut, sassafras, and walnut. The prevailing type of agriculture consists of the growing of the general farm crops—corn, timothy and clover hay, and small grain—together with the production of medium to late truck crops, including Irish potatoes, tomatoes for canning, peppers, and cabbage. The type is highly esteemed for the production of fruit. Peaches, apples, and pears are very successful, and large commercial orchards of these fruits have been set out. The most extensive plantings have been made in the vicinity of Glassboro, Moorestown, and Hammonton. Plate II, figure 2, shows a peach orchard on this type near Hammonton.

In common with the other upland soils the Sassafras gravelly sandy loam, where it adjoins lowlands suitable for pasture, is used to some extent for dairying in connection with the growing of the general farm crops. Nearly every farm maintains one or more cows to provide the home milk supply.

The Sassafras gravelly sandy loam is handled in practically the same manner as is the Sassafras sandy loam. Interplanting is practiced in the orchards for the first two or three years. The older orchards are given clean cultivation and cover crops are commonly grown. The cover crop is seeded about the middle of July and plowed under early in the spring.

This type is much like the Sassafras sandy loam in its crop adaptation and manurial requirements. Owing to the gravel content it is a little more difficult to till, especially when the soil has dried out after a rain.

#### SASSAFRAS COARSE SAND.

The Sassafras coarse sand consists of a grayish to grayish-brown, loose coarse sand about 8 to 12 inches deep, overlying yellow to reddish-yellow coarse sand or loamy coarse sand. Frequently the type contains some small gravel, mostly of quartz.

The Sassafras coarse sand is developed in the southern part of the area, principally in the vicinity of Malaga, Ancora, and Barnsboro. Where it occurs on slopes, the crests of hills, and hillocks the drainage is good to excessive.

The type is not extensive and is unimportant from the standpoint of agricultural value. It is forested chiefly with pine and scrub oak. The small proportion of the type under cultivation is devoted mainly to the growing of sweet potatoes and asparagus.

The soil is greatly in need of organic matter, which may be supplied either by plowing under cover crops or by adding large quantities of manure. Liberal additions of manure or commercial fertilizer are necessary for the production of good yields of any crop.

#### SASSAFRAS SAND.

In the upper 6 to 10 inches the Sassafras sand consists of a yellowish-brown or grayish-brown to brownish-gray loose sand, the darkness of the shade varying with the content of organic matter. In the east-central and southeastern parts of the area, near developments of the Lakewood sand, the color in the surface 1 or 2 inches is very much lighter than is typical. The underlying material is a reddish-yellow or orange-colored, loose to slightly loamy sand. Frequently the upper subsoil is yellow or yellowish-brown in color, and in low situations, as near streams and in depressions where the drainage is imperfect, the subsoil is usually pale yellow. In the low developments along the Delaware River whitish particles, apparently of weathered feldspathic material, are usually present in the subsoil in noticeable quantities. A number of areas of Sassafras coarse sand, fine sand, and loamy sand are included with the Sassafras sand, as mapped, on account of their small size.

There are included with the Sassafras sand on the map areas, covering a few acres, where land has been made by filling in Tidal marsh and parts of the channel of the Delaware River with sand and waste material from the cities, chiefly Camden and Gloucester. Docks and buildings occupy most of this land and it has no agricultural value.

The Sassafras sand is distributed quite generally over the area. Much of the type occurs in strips of various widths along streams, bordered by heavier soils. Large areas are found over the low levels near the Delaware River, and important developments occur near Wenonah, Berlin, Pipers Corner, Hardingsville, Hammonton, Winslow, Newtonville, and to the south of Franklinville.

The topography varies from nearly level to hummocky or hillocky, with some rolling and rather steeply sloping areas along streams. The drainage is good to excessive, crops suffering during dry weather, especially in those places where the water table is comparatively deep beneath the surface.

The Sassafras sand is an important soil in the agriculture of the area. Approximately 50 per cent of the type has been cleared of the natural growth of pitch pine and scrub oak and is under cultivation. It is most highly developed in the vicinity of Thorofare, where small farms prevail and intensive methods of culture are practiced.

The most important crops are sweet potatoes, asparagus, early market tomatoes, cantaloupes, and a number of other truck crops. (See Pl. III, figs. 1 and 2, and Pl. IV, fig. 1.) It has been estimated that 55 per cent of the total acreage in sweet potatoes in the State of New Jersey is on the Sassafras sand and fine sand types in this part of the State.<sup>1</sup> Among the truck crops of moderate importance are watermelons, peppers, eggplant, early peas, beans, and cucumbers. Locally, brier berries are an important product. In the vicinity of Hammonton the type is largely devoted to the growing of dewberries and raspberries. Grapes and peaches also are grown on most of the small farms which prevail in this section of the area.

Many farmers grow some corn, hay (timothy and clover), and oats as feed for the work stock, and to some extent cowpeas, crimson clover, and rye are grown to be turned under for the purpose of augmenting the supply of organic matter in the soil. Most of the farmers keep one or two cows to furnish the home supply of milk, and a few hogs to supply pork products. Dairying is of no importance on this type.

Cantaloupes mature on the Sassafras sand during the month of August. Early tomatoes are usually put on the market from the 1st of July to the 1st of August. Sweet potatoes mature from about the 1st of September to the 1st of October. The marketing of asparagus begins about the latter part of April. In general all crops mature early on this type.

With the same methods of treatment the Sassafras sand produces somewhat heavier yields than the Norfolk sand, which is so extensively used for growing early vegetables in the trucking sections of the States to the south of New Jersey. It is ideally adapted to early

<sup>1</sup> Bonsteel, J. A., Bul. No. 539, U. S. Dept. of Agr., Soils of the Sassafras Series.

truck crops, such as are now grown on many farms, rather than to the later crops, such as tomatoes for canning, which are grown on the heavier soils. It is not a good soil for the general farm crops, and general farming is not practiced to any important extent on farms on this soil.

One-horse and two-horse teams are in common use on the farms, and light implements are generally employed, shallow plowing being given and shallow and frequent cultivation. The soil is very easy to till, and fall plowing is generally practiced. Cedars and other trees are frequently planted around fields to serve as windbreaks, as the soil has a tendency to drift.

In some parts of the area, as in the vicinity of Thorofare, rye and such legumes as cowpeas, vetch, and crimson clover are turned under to supply vegetable matter to the soil, and stable manure is generally applied. Commercial fertilizers are also in common use, the usual mixture analyzing 4-8-10 for truck crops, with the exception of sweet potatoes, for which a 2-8-10 preparation is commonly used. Some farmers use mixtures containing a higher percentage of phosphoric acid than of potash, with reported good results. The ordinary acreage application is 1,000 pounds of commercial fertilizer or 8 to 10 tons of stable manure; on many crops both are used. When green manuring crops are plowed under the application of stable manure is often entirely or partly omitted. Some farmers make light applications of burnt lime.

The present range in value of land of the Sassafras sand, as based upon actual selling prices, is from about \$10 or \$15 an acre to \$125 or \$150, the price depending upon the state of productiveness, improvements, and location.

The Sassafras sand is a soil of rather low inherent productiveness. Liberal applications of manure or commercial fertilizer have been found essential for the production of good yields of any crop. Less fertilization is necessary where the soil is kept well supplied with organic matter, especially when the legumes have been grown in rotations and a crop is occasionally plowed under. Where there is a good content of organic matter the soil conserves moisture better, is less inclined to drift, and in all respects responds more profitably to good farming practices.

#### SASSAFRAS LOAMY SAND.

The Sassafras loamy sand consists of a grayish-brown loamy sand about 6 to 10 inches deep, overlying yellow or orange-colored to reddish-yellow loamy sand which frequently becomes heavier below and then grades lighter in texture, being often a coarse sand or coarse loamy sand in the lower part of the 3-foot section. In forested areas the color in the surface 1 or 2 inches is generally gray or even

dark gray. As mapped, there are included with the type some small bodies of Sassafras sand and sandy loam and some gravelly areas.

The distribution of the Sassafras loamy sand is very similar to that of the Sassafras sand, with which the loamy sand type is usually associated. It is found at slightly higher elevations, separating the lighter types from the heavier types of the series. The surface of the type is undulating to almost flat. Drainage, however, is well developed.

A considerable proportion of the Sassafras loamy sand is under cultivation. It is, however, of little importance in the agriculture of the area because of its small extent. The type is practically identical with the Sassafras sand in its crop adaptations and fertilization and cultivation requirements. With the same manurial treatment it produces slightly higher yields than the Sassafras sand. Crops mature a few days later.

#### SASSAFRAS FINE SAND.

The surface soil of the Sassafras fine sand is a gray to brownish-gray, loose to slightly loamy fine sand, underlain at about 6 to 12 inches by yellow, rather loose fine sand, which becomes more loamy and reddish yellow in color below.

The principal areas of the Sassafras fine sand are found near Pittman, Blackwood, and at Lindenwold. Its surface configuration is undulating or billowy, and drainage is good to excessive.

The type is not very extensive, but practically all of it is under cultivation. The principal crops grown are sweet potatoes, early tomatoes, asparagus, cantaloupes, and watermelons.

Liberal additions of manure or fertilizer are necessary for good yields on the Sassafras fine sand. It is a very easy soil to cultivate, and with the maintenance of a good supply of organic matter it holds sufficient moisture for satisfactory crop production.

#### SASSAFRAS COARSE SANDY LOAM.

The surface soil of the Sassafras coarse sandy loam is a grayish-brown to brown, loamy coarse sand, underlain at 5 or 6 inches by yellow or reddish-yellow coarse sandy loam or sandy clay loam. This passes below into reddish yellow sandy clay, which becomes looser and coarser in the lower subsoil. There is present in places considerable small quartz gravel. Included with the type as mapped are small bodies of Sassafras gravelly sandy loam, loamy coarse sand, and sandy loam. In some parts of the area surveyed the type includes small areas of Colts Neck coarse sandy loam, which is much redder in color than the Sassafras.

The Sassafras coarse sandy loam covers an area of 16.7 square miles. It is developed in the vicinity of Malaga, Newfield, Elmer,

Richwood, east of Franklinville, around Ancora, and elsewhere in the southern part of the area. Its surface varies from hillocky to gently rolling. Drainage is good to excessive.

The Sassafras coarse sandy loam is only partly developed agriculturally. The principal tree growth on the uncleared areas consists of white, red, and black oak, chestnut, and pitch pine. The crops grown are similar to those produced on the Sassafras sandy loam. The growing of the general farm crops of corn, timothy, and clover, together with the production of potatoes, peppers, cucumbers, and tomatoes for canning, constitutes the prevailing system of farming. Peaches and brier berries are grown to some extent in the southeastern part of the area. In the Malaga and Newfield districts this soil is used almost exclusively for the growing of peppers, cucumbers, and grapes.

Land values on the Sassafras coarse sandy loam are somewhat lower than on the sandy loam, as the coarser type is considered inferior in strength. Large quantities of organic matter, such as can be cheaply supplied by the plowing under of leguminous crops, are necessary for the maintenance of a good state of productiveness.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of this type:

*Mechanical analyses of Sassafras coarse sandy loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
170519.....	Soil.....	14.1	41.3	11.5	12.6	7.9	8.8	3.9
170520.....	Subsoil.....	11.3	39.2	12.0	8.0	3.6	9.5	16.6

SASSAFRAS SANDY LOAM.

The surface soil of the Sassafras sandy loam is a brown to grayish-brown loamy sand or sandy loam about 6 to 10 inches deep. The subsoil is a yellow or reddish-yellow heavy sandy loam which passes below into a reddish-yellow sandy clay loam to sandy clay of a friable structure. The lower part of the 3-foot section is characteristically coarse in texture, being more sandy or gravelly than the upper subsoil. In the southern part of the area coarse sand and gravel are frequently present in both surface soil and subsoil in varying proportion. Included with the type are small areas of Sassafras sand, loamy sand, and gravelly sandy loam, as well as of the Sassafras sandy loam, imperfectly drained phase.

The Sassafras sandy loam is the most extensive soil type mapped in the area. It is particularly important in the vicinity of Moorestown, Elmer, Hammonton, Woodbury, Glassboro, Clayton, Newfield,

Williamstown, and Cross Keys. It is found at elevations ranging from 10 to 190 feet above sea level, the topography varying from nearly flat to undulating or slightly rolling. The drainage, on account of the underlying porous strata of sand and gravel, is well established.

The tree growth on the uncleared areas of the Sassafras sandy loam consists mainly of black, white, and red oak, chestnut, sassafras, soft maple, and black walnut. About 60 per cent of the type is under cultivation, devoted mainly to the production of the general farm crops of corn, timothy and clover hay, and the small grains, combined with the cultivation of Irish potatoes (see Pl. IV, fig. 2) and medium and late truck crops, such as tomatoes for canning, peppers, cucumbers, cabbage, sweet corn, peas, beans, and squash. Near Glassboro, Hammonton, and Moorestown large areas of this type are devoted to the production of peaches, apples, and pears. Where waste land adjoins areas of this type dairying is carried on as an incidental interest, the number of cows kept on the farms usually being under 20. Holstein blood predominates in the dairy herds. Dairying is more important in the vicinity of Elmer than elsewhere on the type, and there poultry raising is developed to some extent. A few hogs are raised on the farms, usually only in sufficient number to supply pork products for home use.

Irish potatoes and tomatoes on the Sassafras sandy loam mature about August 1. The period for marketing peppers extends from the latter part of July until the occurrence of frost.

Two hundred baskets (five-eighths bushel) of Irish potatoes, 4 or 5 tons of tomatoes, 300 to 600 barrels of peppers (depending upon the variety), 1½ tons of timothy and clover hay, and about 60 bushels of corn are considered by the farmers fair acreage yields on the Sassafras sandy loam.

Plowing is usually done in the spring, two-horse plows being used. The truck crops receive frequent shallow cultivation. Manure and commercial fertilizers are used for the production of the truck crops. The manure is applied to the land in the fall, and the commercial fertilizer at the time of planting in the row. The common acreage application of stable manure is 8 to 10 tons, and of commercial fertilizer about 1,000 pounds, a 4-8-10 mixture generally being used.

Stump land of the Sassafras sandy loam type, cleared of all salable timber, sells for \$20 to \$40 an acre. Cleared land brings from \$50 to \$175 an acre, depending on the location and improvements.

The Sassafras sandy loam is naturally deficient in organic matter, and the plowing under of cover crops such as crimson clover, vetch, and cowpeas has been found very effective in maintaining the productiveness of the soil as well as in improving its tilth. The appli-

cation of lime is said to be beneficial, especially in obtaining a stand of the legumes such as red clover and alfalfa.

*Sassafras sandy loam, imperfectly drained phase.*—The imperfectly drained phase represents areas of the Sassafras sandy loam in which drainage is not well developed, owing to its low situation. The surface soil to a depth of 8 to 12 inches consists of a brownish sandy loam, essentially the same as the material of the typical soil. The subsoil is a yellowish sandy loam to sandy clay, frequently with grayish mottlings in the lower part of the 3-foot section.

The Sassafras sandy loam, imperfectly drained phase, is of comparatively little importance, owing to its small extent, 5.6 square miles. Its principal development is in the northern part of the area around Moorestown. Most of the land is cleared and cultivated. It is used mainly for growing vegetables and strawberries, but is devoted to some extent to the production of hay and other general farm crops. A larger proportion of it is devoted to the growing of strawberries than of the typical Sassafras sandy loam.

The yields on the phase are naturally lower than those obtained on the typical soil, although drainage when properly installed makes this land nearly equal in agricultural value. Tile drainage seems to give the best results, and many farmers have installed this system. Liming has been found beneficial, as well as the turning under of vegetable matter.

#### SASSAFRAS FINE SANDY LOAM.

The Sassafras fine sandy loam consists of a brown fine sandy loam, underlain at about 6 to 8 inches by a yellow or reddish-yellow fine sandy loam. This passes below into reddish yellow, friable clay, which, in turn, becomes more sandy and loose below.

This type is practically restricted to a belt a few miles wide extending northeast and southwest across the area, the northern boundary reaching from Barnsboro on the west to Medford on the east. Large areas occur near Salina, Laurel Springs, and south of Marlton. The topography is undulating to steeply rolling, the land having been dissected in many places by small streams. The type is naturally well drained.

The Sassafras fine sandy loam is mostly in cultivation, and it is considered a strong soil. It compares favorably with the Sassafras loam, the yields on the two soils being about the same. The general farm crops—corn and hay—are grown, in conjunction with truck crops, such as Irish potatoes and tomatoes, the latter for canning. In many places the type is bordered by areas of the Portsmouth and Elkton soils, which afford pasturage for cattle, and here dairying is an important interest.

The growing of winter cover crops, to be plowed under in the spring, is a practice that has been demonstrated to improve the productiveness of the type, in addition to lessening the effects of erosion on some of the slopes. This soil apparently would be easier to improve than the Sassafras sandy loam.

#### SASSAFRAS LOAM.

The Sassafras loam consists of a brown, mellow loam, underlain at about 5 to 8 inches by reddish-yellow, friable clay which contains more sand or gravel and is looser in the lower subsoil. The upper subsoil is often yellow, with a reddish-yellow shade appearing below. The subsoil is heavier than that of the Sassafras sandy loam, but is nevertheless friable. Along the lower lying margins of the areas, especially near poorly drained soils, the drainage of the Sassafras loam is poorer than typical and the subsoil is yellower in color, with mottlings of gray frequently developed in the lower part of the 3-foot section.

The Sassafras loam occurs in large areas in the vicinity of Moorestown, Merchantville, Haddonfield, Coflins Corner, and Elmer. It occupies undulating to nearly level country. The type is naturally well drained.

Practically all the Sassafras loam is under cultivation, and it is considered one of the most desirable soils in the area for the production of corn, timothy and clover hay (see Pl. V, fig. 1), and small grain, general farming being carried on in conjunction with the growing of Irish potatoes, tomatoes for canning, and other truck crops suited to the heavier soils. Near Moorestown and Merchantville there are large, thriving peach and apple orchards on this type. In the vicinity of Elmer, as well as in other sections of the area where the type occurs adjacent to poorly drained soils, dairying is an important industry.

Acreage yields of 200 to 300 bushels of Irish potatoes,  $1\frac{1}{2}$  tons of hay, and 75 bushels of corn are considered reasonable by the farmers.

The methods of farming employed on this type are, on the whole, commendable. In preparing land for crops the ground is broken with 2-horse and 3-horse turning plows. The crops receive frequent seasonal cultivation, multitoothed harrows and cultivators being used. The common practice where grass follows potatoes or tomatoes is to disk the field and sow the timothy as soon as these crops are removed, this being usually about the middle of August. Commercial fertilizer is applied to truck crops at the time of planting, while manure is applied usually the fall before plowing. The most common commercial-fertilizer preparation used is a 4-8-10 mixture, 1,000 pounds per acre being the usual application. From 8 to 10 tons per acre of stable manure is commonly applied.

Land of the Sassafras loam type is valued at \$150 to \$225 an acre, the price depending upon the location and improvements.

Moderate applications of lime have proved beneficial on this type, the lime preferably being applied following the growing of the potato crop in the rotation.

#### COLLINGTON GRAVELLY LOAM.

The surface soil of the Collington gravelly loam is a brown gravelly loam 4 to 5 inches deep, overlying a greenish, stiff clay which frequently shows reddish-brown or chocolate-red mottlings in the lower subsoil. The green color is due to the influence of glauconite. Small quartz particles are abundant in the surface soil and occur to a much less extent in the subsoil. Included within the type as mapped are small bodies of Collington clay as well as negligible areas in which the material in the surface few inches consists of brown sandy loam well mixed with gravel.

The principal developments of the Collington gravelly loam are north of Fairview, in the vicinity of Magnolia, and south of Mantua. There are small, unimportant bodies in many places in the northern half of the area surveyed. The type occupies some of the comparatively steep stream slopes, as well as many knobs and crests of hills. Drainage is fairly well established.

The Collington gravelly loam is of little importance in the agriculture of the area. Approximately 90 per cent of the type is undeveloped, remaining covered with a second or third growth of white, red, black, and other oak, with some chestnut and a few pine trees. The land not used for pasture is devoted to the production of the general farm crops, late truck, and fruit. The unfavorable situation of the type, the plastic, heavy nature of its subsoil, and its large content of gravel are apparently the principal factors in the low state of development of the type.

#### COLLINGTON SAND.

To a depth of 6 or 8 inches the Collington sand consists of a light-brown to brownish-gray sand or loamy sand, overlying yellowish, rather loose sand. This yellow sand passes below into greenish-yellow or almost green, loose to loamy sand. Often faint yellowish mottling is noticeable in the subsoil of areas of the type occupying the lower situations. The green color is due to the presence of glauconitic sand. The typical soil contains such a large percentage of glauconite or greensand that it is locally termed "pepper-and-salt land." In places the texture is rather coarse, while, on the other hand, there are some included patches of fine sand, as in the vicinity of Evesboro and Mount Laurel. The type grades into the Sassafras sand in such a way that it is not everywhere easy to draw distinct boundaries.

Large areas of Collington sand occur along the banks of Rancocas Creek. There are other important developments near Mount Laurel, and many smaller bodies are mapped here and there throughout the northern half of the Camden area. The topography is slightly sloping or gently rolling, and drainage is excessive.

Much of the Collington sand is still forested, pitch pine being the prevailing growth. Considerable areas of the type along the branches of Rancocas Creek have been dug over to obtain material for molding in the near-by foundries.

The type is not important in the agriculture of the area. Where it is cultivated, sweet potatoes, asparagus, early tomatoes, cantaloupes, watermelons, and various other truck crops are produced for early marketing. Peaches are grown to some extent on the type. Crops mature on the Collington sand about the same time as on the Sassafras sand. The yields on the Collington sand are apparently lower, and the type is not developed to the same extent as is the Sassafras sand.

The Collington sand is much in need of organic matter. This can be added economically by plowing under crops of legumes, such as cowpeas and crimson clover. Where manure can be obtained cheaply it can be added to advantage, and applications of lime probably would be beneficial.

#### COLLINGTON SANDY LOAM.

The typical Collington sandy loam consists of a brown sandy loam about 8 to 15 inches deep, overlying yellowish-brown to yellow sandy loam. This passes quickly into greenish-yellow to greenish-brown, friable, rather stiff sandy clay, frequently containing more sand and having a looser structure in the lower part of the 3-foot section. Much of the type ranges so close to the Sassafras sandy loam in characteristics that it is difficult to draw sharp boundaries between the two types, but the typical Collington material contains sufficient greensand to impart a shade of green, at least in the lower subsoil. Often the subsoil is a reddish-yellow sandy clay containing just enough greensand material to give the greenish shade. In other places it is a distinctly green clay of a stiff, plastic nature, the clay occasionally being encountered near enough to the surface to be reached by deep plowing. There is included with the type a small development of Collington loamy sand near Lumberton, Eayrestown, and Lippinseotts Corner.

The most important areas of the Collington sandy loam are situated near Woodbury, Mount Holly, and Marlton. The surface is characteristically undulating or gently rolling, and the drainage is good.

The type is nearly all under cultivation and it is an important soil in the agriculture of the area. In general, the same crops are grown as on the Sassafras sandy loam. The prevailing system of farming consists of growing the general farm crops—corn, timothy, clover, and small grains—together with Irish potatoes, tomatoes for canning, cabbage, peppers, and other medium to late truck crops. Alfalfa does well on the type.

Orcharding is not so important as on the Sassafras sandy loam, as much of the latter type occurs at somewhat higher levels, where natural conditions are more favorable to fruit growing. Crop yields and the methods of farming are about the same on the two types. Both stable manure and commercial fertilizers are used for the truck crops, but the general farm crops receive little or no fertilization. The common acreage application is 1,000 pounds of a 4-8-10 mixture or 8 to 10 tons of animal manure. Often both the manure and the commercial preparation are applied to the same crop, the former being distributed in the fall and the latter in the row at the time of planting.

Land of the Collington sandy loam type is sold in large tracts at prices ranging from \$100 to \$175 an acre, the value varying with the location and improvements. Much of the type situated near steam and electric lines is held at higher figures on account of its value for building purposes.

The type as a whole is well farmed, though in a few instances it would be advisable to adopt some regular crop rotation, to include at least one leguminous crop. A beneficial rotation would consist of corn, a truck crop, and clover or clover and timothy. A winter cover crop to be plowed under in the spring could be planted at the last cultivation of the corn. Applications of lime probably would prove beneficial to this soil.

*Collington sandy loam, deep phase.*—The deep phase of the Collington sandy loam consists of a yellowish, loose sand, rather loamy below the surface stratum. This is underlain at any depth from 14 to 30 inches by a yellowish to reddish-yellow friable sandy clay, which passes into a greenish-yellow, more compact sandy clay. Often the upper 1 or 2 inches of the soil is darker in color than typical, owing to the accumulation of organic matter. Greensand in varying quantities is encountered throughout the 3-foot section. In many places there is sufficient glauconitic sand in the surface soil to impart to it a greenish shade, though in general this material is not conspicuous above the subsoil. In places the lower subsoil consists of a green, stiff, plastic clay. Some small unimportant areas in which the material is fine enough in texture to be classed as Collington fine sandy loam, deep phase, are included with this soil.

The principal areas of the Collington sandy loam, deep phase, are mapped near Almonesson, Mount Holly, Evesboro, Medford, Woodbury, and Barrington. Important developments occur elsewhere in the northern half of the Camden area. The phase occupies gently rolling country and is naturally well drained. Nearly all the land is in cultivation, and the phase is of considerable importance agriculturally.

Farmers on the phase report it to be an excellent soil for sweet potatoes, cantaloupes, early tomatoes, asparagus, watermelons, eggplant, and other truck crops. Most of the farmers grow corn and hay (timothy and clover) to some extent for home use.

Asparagus is the first crop to be gathered, usually being cut late in the spring. Early tomatoes are gathered during July and cantaloupes the latter half of August. Sweet potatoes are harvested usually during September and October.

Yields on the Collington sandy loam, deep phase, according to field observations and information gathered from a number of farmers, are a little higher than on the Sassafras sand under similar methods of farming. Farmers report that on account of the underlying clay this soil holds moisture better than do the deeper sands. At the same time the sandy surface soil warms up early in the spring and the phase has the desirable qualities of the sand types without the disadvantages of their droughtiness. The soil is managed in practically the same way as are the other light-textured soils of the area. Many of the farms are small and often one-horse implements are used exclusively. Alternation of crops, rather than rotation, is practiced on the smaller farms. Large quantities of commercial fertilizer and stable manure are applied. The commercial mixture commonly used for sweet potatoes analyzes 2-8-10, while a 4-8-10 preparation is usually applied to the other truck crops.

Land of the Collington sandy loam, deep phase, is usually disposed of in conjunction with other soil types. Some of the farms where all, or nearly all, of the soil consists of the phase sell at \$50 where all, or nearly all, the soil consists of the phase sell at \$50 to \$125 an acre, the price varying with the improvements and location.

The Collington sandy loam, deep phase, is in general greatly benefited by the addition of organic matter. The soil is improved by the same practices that are effective with the Sassafras sand.

#### COLLINGTON FINE SANDY LOAM.

The Collington fine sandy loam consists of a brown fine sandy loam, underlain at 8 to 12 inches by a yellowish fine sandy loam. This passes quickly either into a greenish-brown to greenish-yellow, moderately friable fine sandy clay or into a reddish-yellow fine sandy clay which passes below into the greenish-brown to greenish-yellow

fine sandy clay. In places the lower subsoil is more friable than the upper subsoil, while elsewhere it may consist of a green, stiff, plastic clay. As mapped, the type includes small bodies of Collington loam and sandy loam. It grades so gradually into areas of the Sassafras soils that the boundary between the types can not everywhere be accurately placed on the map.

Large tracts of the Collington fine sandy loam are developed in the northern half of the area. The type is especially important near Lumberton, Masonville, Medford, Fellowship, Haddonfield, Magnolia, and Wenonah. It occupies slightly undulating country and is naturally well drained.

The Collington fine sandy loam is the most important soil in the northern half (marl region) of the Camden area. Fully 90 per cent of its total extent is under cultivation, the undeveloped land being forested with white oak, red oak, and other oak, sweet gum, ash, chestnut, and wild cherry. The type is chiefly devoted to the growing of canning tomatoes and Irish potatoes, in conjunction with general farming. Good crops of corn, timothy, clover, rye, and oats are produced. Many acres of this soil are planted to such truck crops as cabbage, peppers, and sweet corn, and there are several large commercial orchards of peaches, apples, and pears. A few farmers on the type, who have cheaper land adjoining, carry on a system of dairy farming, with trucking and general farming as adjuncts. The herds usually consist of about 6 to 12 grade Holstein cows. The milk is sold to dairymen in the cities or is disposed of directly in the near-by towns.

Irish potatoes mature about August 1 and are usually marketed at once. Canning tomatoes ripen in August and the vines bear for a number of weeks.

According to farmers on this type the yields are good. Irish potatoes yield about 200 bushels per acre, tomatoes about 5 tons, corn 60 to 80 bushels, and hay (timothy and clover) about  $1\frac{1}{2}$  tons.

Most of the farmers on this soil follow a crop rotation, though many grow potatoes or truck crops on the same land 2 or 3 years in succession. Modern farm implements, such as potato planters and diggers, hay loaders, weeders, riding cultivators, sulky plows, and disk and smoothing harrows, are in common use. The truck crops are fertilized with both stable manure and commercial preparations. A 4-8-10 formula is usually employed. The advisability of spraying the potato vines and orchard trees is understood and spraying is commonly practiced. Many farmers grow cover crops of crimson clover, winter vetch or rye in the orchards, to be plowed under the following spring. A few farmers plant turnips with the cover crop, to be harvested after frost.

The more extensive growing of cover crops would be beneficial on this soil. The green manuring material when heavy should be disked well before being plowed under, so that it will not form a layer underground to prevent the rise of soil moisture. Liming the soil is said to be beneficial.

#### COLLINGTON LOAM.

To a depth of about 8 to 12 inches the Collington loam consists of a dark-brown, mellow loam, with an underlying subsoil of reddish-brown, friable clay loam which passes quickly either into a green, plastic clay or into a greenish-yellow or greenish-brown, friable fine sandy clay. The lower subsoil is usually a green, plastic clay, though in places it is more sandy than the surface soil. The heavy, green clay lies near the surface in a few places. Frequently the surface soil contains a relatively high content of fine sand, and in places large quantities of fine micaceous material are mixed through the surface soil and subsoil in such a way as to impart a shiny appearance and a greasy feel. Where the Collington loam borders the Sassafras loam the two soils grade into each other so gradually as to make separation difficult; the chief difference is often the greenish shade in the lower subsoil of the Collington.

The Collington loam is inextensive. It occurs for the most part near Collingswood and Lumberton and west of Marlton. The topography ranges from nearly flat to gently undulating, the type lying 50 to 150 feet above mean tide level. It is naturally a well-drained soil.

The type is of considerable importance agriculturally. It is practically all under cultivation, being devoted to the same crops as is the Collington fine sandy loam, with which type it is generally associated. It differs from the fine sandy loam mainly in being a slightly stronger soil, giving somewhat higher yields of Irish potatoes, corn, oats, and timothy and clover hay. Truck crops, however, give somewhat lower yields. The methods of farming, the fertilization given, and the selling price of the land are practically the same as in the case of the Collington fine sandy loam, and the type responds to the same methods of soil improvement.

Below are given the results of mechanical analyses of samples of the soil and subsoil of the Collington loam.

#### *Mechanical analyses of Collington loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
170543.....	Soil.....	1.2	5.0	6.2	32.9	18.9	20.7	15.5
170544.....	Subsoil.....	.2	1.9	3.4	24.0	10.2	9.8	50.4



FIG. 1.—SWEET POTATOES ON SASSAFRAS SAND, NEAR WOODBURY.

The topography shown is characteristic of that over much of the type.

87414



FIG. 2.—EARLY TOMATOES ON SASSAFRAS SAND, NEAR THOROFARE.

88093



87417

FIG. 1.—CANTALOUPE ON SASSAFRAS SAND, NEAR WOODBURY.



88088

FIG. 2.—IRISH POTATOES ON SASSAFRAS SANDY LOAM, NEAR HURFFVILLE.

Showing level surface which characterizes much of this type.

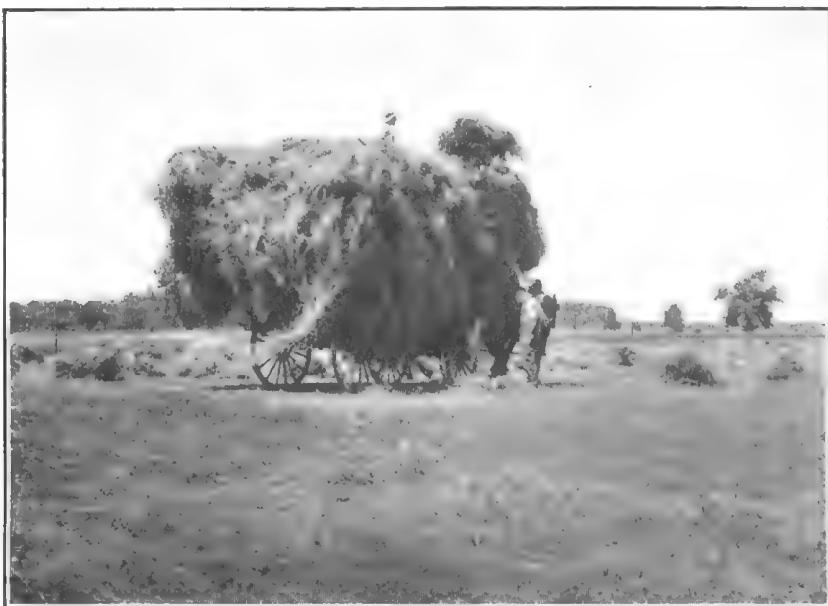


FIG. 1.—TIMOTHY HAY ON SASSAFRAS LOAM, NEAR MOORESTOWN.



FIG. 2.—HOLSTEIN CATTLE GRAZING ON DIKED TIDAL MARSH, NEAR WOODBURY.



## COLLINGTON CLAY.

Areas mapped in the Collington fine sandy loam color but marked with the inclusion symbol represent the Collington clay. The typical Collington clay consists of a green, stiff, sticky, plastic clay loam to clay, the material frequently showing a dark-bluish shade in the lower subsoil. Occasionally the subsoil is mottled with rusty brown. In places there is a surface covering, 1 to 5 inches deep, of greenish-brown to brown sandy clay loam or sandy clay, while in other places there is 1 or 2 inches of light-grayish or whitish sand over the heavier material. Usually some small quartz gravel particles are distributed over the surface. Where the heavy clay comes to the surface the soil cracks on drying and is very sticky when wet. The Collington clay is locally called "green land."

The type is of small extent, covering an area of only 1.1 square miles. The principal areas occur near Blackwood, Magnolia, and Sewell. The surface is characteristically sloping, broken by numerous gullies. The type occupies stream slopes and knobs, and surface drainage is good, though the internal drainage is imperfect.

The Collington clay is not of much importance in the agriculture of the area. Only about 10 per cent of the land is cleared. The forest growth consists mainly of white, red, and other oak. The type is used to best advantage as hay or pasture land, and most of it is devoted to pasturage. It is considered a poor soil because of its unfavorable topography and the intractable nature of the material. Where farmed it is usually kept in grass, although in places small fields have been made to produce fair yields of timothy and clover hay, corn, and small grain.

## SHREWSBURY SANDY LOAM.

The Shrewsbury sandy loam consists of a brown sandy loam, underlain at about 6 to 10 inches by a mottled yellowish-brown, rusty-brown, and greenish sandy clay. In places strata or pockets of loamy sand or sand are encountered in the subsoil. Greensand is present in varying proportions, this material usually increasing in content with depth. A few small areas are included where the subsoil material resembles that of the sandy loam type of the Elkton series, but differs in containing large quantities of glauconite.

The Shrewsbury sandy loam occurs for the most part in the vicinity of Medford, Marlton, Mount Laurel, and Somerdale, although there are small patches scattered here and there throughout the northern half of the area. The type occupies flats and gentle slopes, usually being developed in positions between the Keansburg loam and the Collington soils. Drainage is imperfect, though not so poor as that of the Keansburg loam. The greater part of the type has been tile drained.

The Shrewsbury sandy loam is an important soil in the northern half of the area. It is practically all cleared. The drained land is devoted chiefly to the production of Irish potatoes, tomatoes for canning, cabbage, peppers, strawberries, corn, timothy, clover, oats, wheat, and rye. The general farm crops are usually consumed on the farm where grown, by work stock, dairy cows, and poultry. The bulk of the truck produced is sold to the Philadelphia and Camden markets. The undrained part of the type is used principally for pasturing dairy cattle and idle work horses. The dairy herds seldom consist of more than a dozen cows. Dairying is carried on by a number of farmers as an adjunct to general farming or in a combination of trucking and general farming. The milk is mainly sold to dealers who carry it to the city for delivery, though a few farmers deliver their own milk in the near-by towns.

Potatoes on this type are harvested about August 1. Tomatoes are a week or two later in ripening. The Shrewsbury sandy loam is not an early soil, on account of its wet nature. Yields are good, but lower than upon the Sassafras loam. Crop rotations are usually practiced on the farms, a common rotation consisting of corn one year, truck (potatoes, tomatoes or peppers) one year, wheat one year, and timothy and clover, for hay, two years.

The fertilizer used on the Shrewsbury sandy loam is applied to the truck crops. When grass is seeded it is sown usually on the soil from which potatoes or other vegetables have been removed. The seed bed is prepared by simply disking and harrowing the field. The type as a whole is handled under about the same methods as are the Sassafras loam and sandy loam.

Land of the Shrewsbury sandy loam, where drained, is valued at \$75 to \$150 an acre.

The type requires better drainage, liming, and the incorporation of organic matter at occasional intervals.

#### ELKTON LOAM.

The typical Elkton loam consists of a brownish-gray or ashen-gray loam, underlain at about 6 to 10 inches by mottled grayish and yellowish sandy loam to sandy clay. In places the upper subsoil is pale yellow, but gray mottling appears below, the lower subsoil being in some areas a light-gray or bluish-gray sandy loam or sandy clay. Frequently the lower subsoil is lighter in texture than the upper subsoil. Some of the land mapped as the loam is rather a sandy loam. In patches the type in its characteristics ranges close to the Portsmouth series or a poorly drained phase of Sassafras. Small patches of Keyport sandy loam, loam, and silty clay loam are included with this type. These consist mainly of brown loam underlain at

about 8 inches by yellowish, friable clay which passes below into a stiffer clay of gray or drab to mottled yellowish and grayish color. The Keyport soils are developed principally 1½ miles northwest of Moorestown and 2 miles north of Elmer.

The Elkton loam is mapped in numerous small bodies throughout the area, but principally in the northern part. It is a rather inextensive soil. The type is developed in low situations with nearly level to slightly sloping surface. The drainage is imperfect, but not so poor as that of the Portsmouth soils. Many of the cultivated fields are drained with tile.

About half the total extent of the Elkton loam is cleared, the remainder of the land being covered with a second stand of soft maple, water and other oak, and willow, with a dense undergrowth of brier berries, hanging vines, ferns, sassafras, laurel, magnolia, huckleberry, and grasses. The cleared areas which have not been drained are used principally as pasture land. Where drainage has been installed the type is devoted to the production of peppers, canning tomatoes, cabbage, onions, and strawberries, as well as the general farm crops, mainly corn, timothy, clover, and small grain. Yields are lower than on the Sassafras loam.

Dairy cows and work horses are pastured upon the type. Holstein-Friesian blood predominates in the grade milch cows, except where only one or two cows are kept to supply the needs of the farm, in which case the Jersey grade is the common type of animal.

Tomatoes begin to ripen on the Elkton loam about the middle of August. The type is rather late in getting into condition for planting, on account of its comparatively heavy nature, and crops naturally do not mature early.

The Elkton loam is handled in practically the same manner as are the other loams of the area. Somewhat heavier applications of manure and fertilizer are made, however, and lime is applied more often and in larger quantities. The lime is usually purchased in bulk in the unslaked form (quickslime, burnt lime or lump lime), and is placed in large piles until air-slaked, being then spread over the field with a lime spreader, manure spreader, grain drill or by shovel.

As this type occurs in rather small developments, it is impossible to assign to it definite selling prices. It is considered to be of lower value than soils of the Sassafras and Collington series.

For best results the Elkton loam as a whole requires better drainage, liming, and the incorporation of organic matter. Tile drains seem to give the best results. The less expensive open-ditch system provides satisfactory drainage, but is probably the more costly in the end, and incidentally the ditches render considerable good land unavailable for cultivation. The addition of organic matter tends to

overcome a tendency the soil has to bake during dry seasons. Where the type can not be drained it probably can be used to best advantage for growing grasses for pasture, as is recommended by the New Jersey Agricultural Experiment Station.

Mechanical analyses of samples of the soil and subsoil gave the following results:

*Mechanical analyses of Elkton loam.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
170523.....	Soil.....	1.3	23.3	9.3	15.2	8.7	30.5	12.0
170524.....	Subsoil....	4.0	33.8	10.6	12.9	7.7	21.4	9.9

KEANSBURG LOAM.

To a depth of 5 to 12 inches, the surface soil of the Keansburg loam is a dark-brown to black loam, underlain by a dark-greenish to mottled yellowish, bluish, and greenish plastic clay. In some places the subsoil is bright yellow, with mottlings of blue and green in the lower part. Pockets or strata of sandy material are occasionally encountered in the subsoil. In places the soil of included areas is brown or grayish brown, representing unimportant developments of the Shrewsbury loam.

The Keansburg loam is a somewhat important type in the northern part of the area. It occurs principally in the vicinity of Marlton, Medford, Fellowship, Mount Laurel, and east of Lumberton. It occupies low, flat situations and is poorly drained, especially in the subsoil. Much of the type is drained with tile or open ditches.

The natural tree growth on the Keansburg loam is water oak, maple, sweet gum, and willow. Most of the type has been cleared and drained. The principal crops grown are corn, timothy, clover, and strawberries, and such vegetables as peppers, cabbage, onions, and lettuce. By far the greater part of the type is used for pasturing milch cows and work horses. The milk is sold on the Philadelphia and local markets.

The soil is naturally rather late in warming up in the spring, because of its compact nature. Vegetables mature 10 days to 2 weeks later than on the better drained soils.

Yields of the general farm crops on the Keansburg loam, where it is drained and properly handled, are high. Farmers report corn as yielding 80 to 100 bushels per acre and timothy and clover hay 1 to  $1\frac{1}{4}$  tons.

The tillage methods practiced on this type are practically the same as those followed on the Sassafras loam, although the Keansburg

loam is rather restricted in the range of moisture conditions under which it can be plowed satisfactorily. Crops do not receive as much manure or commercial fertilizer as on many of the other soils.

The Keansburg loam is potentially one of the most productive soils in the area. Under proper management it is not surpassed as a corn or hay soil. It is well adapted to lettuce, celery, onions, and strawberries. Applications of lime have given favorable results on this soil. The wetter tracts, where drainage is impracticable, can be used to best advantage as pasture land.

Below are given the average results of mechanical analyses of samples of the soil and subsoil, and a single analysis of a sample of the lower subsoil of this type:

*Mechanical analyses of Keansburg loam.*

Number.	Description.	Fine	Coarse	Medium	Fine	Very fine	Silt.	Clay.
		gravel.	sand.	sand.	sand.	sand.	cent.	cent.
170557, 170570.....	Soil.....	0.3	2.4	2.6	41.2	11.6	19.4	22.5
170558, 170571.....	Subsoil.....	.1	.7	1.4	22.3	13.0	21.5	41.1
170572.....	Lower subsoil.....	1.2	2.3	1.0	47.8	18.9	13.0	15.9

**LAKWOOD SAND.**

The surface soil of the Lakewood sand consists of a loose white sand, underlain at any depth from about 6 to 20 inches below the surface by orange-colored sand that is somewhat more compact than the subsoil material. This sand stratum is not so loamy as is the subsoil of the Sassafras sand. In places the upper subsoil is of a coffee-brown color and is rather compact in structure, becoming orange colored and loose textured below. In forested areas the immediate surface soil is grayish, owing to the accumulation of more organic matter. Coarse sand and small quartz particles are sometimes encountered through the soil in varying proportions.

The Lakewood sand is mapped in large areas in the east-central and southeastern parts of the Camden area. It is one of the most extensive soils mapped. The largest bodies occur south of Medford near Taunton, Braddock's Mill, and Jackson. South and southwest of Hammonton there are large areas of the type occupying the gentle slopes approaching swamps and streams. The topography is undulating to gently rolling or hillocky, and the drainage is excessive.

The Lakewood sand, owing to its droughty, leachy nature, is practically undeveloped, supporting a cover consisting mainly of pitch pine, with some oak in the lower places. The timber is given little chance to develop, as forest fires run over the land in the dry seasons, and the growth is of little value. The undergrowth, mainly

huckleberry, laurel, ferns, and coarse grasses, also is kept well thinned by the fires.

The Lakewood sand constitutes the greater proportion of the section of the area known locally as the sand region. Through this district there are few improved roads, these leading to the coast resorts, and the very scattered population is dependent for a livelihood upon picking huckleberries, working in the cranberry bogs, and in gathering holly for sale at the holiday season. The land sells at prices ranging from \$1 to \$15 an acre. Practically the only sales are made to persons who wish to convert the adjacent swamps into cranberry bogs, and who find it necessary to purchase a large extent of land in order to control the water.

The Lakewood sand has, in other sections of southern New Jersey, been used to some extent for such crops as asparagus, sweet potatoes, and early tomatoes. In order to grow crops profitably commercial fertilizer or stable manure must be used in liberal quantities. The plowing under of vegetable matter helps to make the soil more retentive of moisture. It may prove profitable to employ overhead irrigation.

#### HYDE LOAMY SAND.

Over much of the type the Hyde loamy sand to a depth of about 6 to 10 inches consists of black sandy muck or mucky sand, underlain by black loamy sand which becomes coffee brown in color with depth. In places the black layer overlies grayish, looser sand, which becomes brown below. In the lower places immediately along streams there is usually a layer, 12 to 24 inches or more thick, of black muck to mucky silt loam overlying black loamy sand. There are included some areas of Portsmouth sand, but over most of the type the material is black through the surface soil and upper subsoil and brown below. Some included patches contain sufficient coarse vegetable matter to be classed as Peat.

The Hyde loamy sand occurs in important developments in the east-central and southeastern parts of the area, in low, wet places or seepage flats along streams and about the stream heads. Immediately along the streams the type includes some low strips, where much of the material consists of alluvium. The Hyde loamy sand is very poorly drained, the material remaining saturated from the surface or near the surface downward throughout the year.

About 20 per cent of the type has been cleared. The native growth consists mainly of cedar, pitch pine, highbush or swamp huckleberry, and ferns, except along the lower strips near the streams, where the chief growth is bay or "magnolia," swamp maple, gum, azalea, and ferns. Where there is a growth of cedar the local designation of the land is "cedar swamp" or "cedar brakes"; where pine is more abundant the land is known as "pine swamp."

A number of the swampy Hyde loamy sand areas have been cleared and are used for the production of cranberries, which form the only merchantable product in addition to timber. Cranberries on this type are picked in late August and early September. As the bogs are in depressions where there is danger of early fall frosts, harvesting is hastened. The berries are run through a separator, passed over screens, and pressed into 100-quart barrels. They are sometimes kept many weeks after picking before being disposed of. Nearly all the growers sell through a cooperative growers' association. Estimates based upon statistics gathered from many sources give 32 barrels per acre as about the average yield, although 60 to 75 barrels per acre are produced in favorable seasons by many growers.<sup>1</sup>

Undoubtedly many of the swamps occupied by Hyde loamy sand would, if cleared, drained, and properly farmed, produce good yields of lettuce, celery, onions, late strawberries, and other crops which do well on mucky soil.

The following table gives the results of mechanical analyses of samples of the soil and subsoil of the Hyde loamy sand:

*Mechanical analyses of Hyde loamy sand.*

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
170531.....	Soil.....	3.9	30.3	16.3	30.1	1.9	5.8	11.6
170532.....	Subsoil.....	2.4	22.8	15.2	45.9	5.1	2.6	5.9

PORSCMOUTH SANDY LOAM.

The Portsmouth sandy loam consists of a dark-gray to black sandy loam overlying grayish loamy sand, which passes into dark-brown or coffee-colored sandy loam, this becoming lighter or yellowish brown below. In places the dark-brown material is encountered immediately beneath the black surface soil. Part of the type has a light-grayish to pale-yellowish or mottled yellow and gray sandy loam to sandy clay subsoil.

There are included with the Portsmouth sandy loam, as mapped, unimportant patches of Portsmouth sand, loam, and fine sand, as well as of Elkton loam and sandy loam; also patches of a variation in which the upper subsoil is pale yellow, much like that of the Norfolk, with yellowish and grayish shades below. In a few small bodies mapped the lower subsoil contains particles of iron-crust

<sup>1</sup> See "The Cranberry Industry," by L. J. Fosdick, 41st Annual Report N. J. State Board of Agriculture; also "Cranberry Culture," by L. C. Corbett, Farmers' Bul. 176, U. S. Dept. of Agr.

material and iron concretions in such quantities as to give to it a rusty-brown color.

The Portsmouth sandy loam is developed in depressions, often at the head of streams or along the margins of swamps throughout the area. Some of the larger bodies are mapped near Berlin, south and east of Medford, north of Taunton, and south of Marlton. The surface is flat or only faintly sloping and drainage is poor, water standing over much of the type during periods of excessive rainfall. Artificial drainage systems have been installed in the cultivated areas.

The Portsmouth sandy loam is an extensive soil, but most of it is still covered with a growth consisting of a variety of magnolia, pitch pine, sweet gum, swamp maple, and cedar, with an undergrowth of climbing brier vines, huckleberry, ferns, and coarse grasses. The principal use of the type is for pasturage, many dairy cows being grazed upon it. The type makes good pasture land when seeded to pasture grasses. The cultivated areas are used for growing corn, timothy, and clover, in addition to strawberries, canning tomatoes, late cabbage, onions, peppers, lettuce, celery, and other truck crops. Where the land is properly drained and limed strawberries, onions, lettuce, cabbage, corn, and hay are profitable crops. Celery when properly handled also succeeds.

The methods of farming employed are similar to those practiced in general on the upland soils. Not quite so much fertilizer is applied to truck crops, however, as on the higher lying and better drained types.

The type is greatly in need of better drainage, and applications of lime, as well as of potash and phosphoric acid, have proved especially beneficial.

#### PORTSMOUTH LOAM.

The typical Portsmouth loam consists of a black mucky loam, underlain at about 6 to 15 inches by grayish or mottled gray and yellow sandy loam to sandy clay. In places the subsoil is dark brown to black in color, and not heavier than a sandy loam in texture. A few small bodies are included where the subsoil differs in being a stiff, plastic clay. Unimportant developments of Portsmouth sand and sandy loam and Elkton sandy loam and loam also are unseparated.

The Portsmouth loam is an inextensive type. Small developments are mapped near Woodbury, Glassboro, Elmer, and Moorestown, as well as elsewhere throughout the area. The type occupies situations similar to those occupied by the Portsmouth sandy loam, that is, in depressions in which drainage is poorly established. Water stands on the undrained land most of the year.

This type is not important in the agricultural development of the area. Fully 90 per cent of the land is covered with a second or third growth of sweet gum, swamp maple, and magnolia, with some oak, pine, and sycamore, and a dense undergrowth of laurel, briars, huckleberry, and coarse grasses. Most of the type is used for pasturing dairy cows and work horses. Corn, timothy, and clover, and peppers, cabbage, late tomatoes, strawberries, and other truck crops are grown on the drained areas.

The soil is slow in warming up in the spring and crops are a number of days later in maturing than on the better drained loams.

The Portsmouth loam, when drained and limed, is in general a good, productive soil for corn, hay, strawberries, and late truck crops. It is naturally rich in organic matter, and ranks higher in agricultural value than is generally realized, as has been proved in the few instances where the type has been drained and limed, and proper methods of tillage practiced.

#### NORFOLK FINE SAND.

The surface soil of the Norfolk fine sand is a brownish-gray to gray, loose fine sand, underlain at 5 to 8 inches by a pale-yellow to medium-yellow, loose fine sand. Frequently in the lower few inches the subsoil consists of orange-colored fine sand, approaching in shade the characteristic Sassafras subsoil.

The Norfolk fine sand is not an extensive soil. It is developed in that part of the area just south of the region of marl formations, the largest bodies occurring southeast of Medford and near Clementon and Turnersville. The type is usually associated in occurrence with the Sassafras fine sand and fine sandy loam. Much of the land has been dissected into small, cone-shaped knobs or hillocks by erosion, though in some places the topography is only undulating or nearly flat. The drainage ranges from good to excessive.

The greater proportion of the type is covered with a scattered growth of scrub oak and pitch pine. Holly, sassafras, mountain laurel, and huckleberry form the principal undergrowth. Sweet potatoes, cantaloupes, early tomatoes, watermelons, and other varieties of truck are the chief crops grown, with corn and hay produced to some extent. On account of the low content of organic matter, the generally excessive drainage, and the unfavorable surface characteristics of much of the type, it is not a popular soil for farming. Yields are lower than on the Sassafras fine sand.

The Norfolk fine sand is benefited by the incorporation of large quantities of organic matter. This can be done by plowing under green crops of legumes, as well as by the addition of manure. Such treatment increases the moisture-holding capacity of the soil and improves its physical condition, in addition to adding plant food.

Under careful management this soil could be made to produce good crops of early vegetables.

#### FRENEAU LOAM.

Pervadingly, the Freneau loam consists of a dark-brown or mottled rusty-brown and brown loam, underlain at about 7 inches by material which varies from place to place, but is usually a mottled rusty-brown, bluish-gray, bright-yellow, and greenish-brown sandy clay to silty clay, containing strata of loamy sand and sandy loam. In places the subsoil is a green or dark-green to dark-bluish silty clay containing much glauconitic material. Frequently, in the lower, swamp situations, the surface material is a black, silty, mucky loam. There are included with the Freneau loam as mapped small areas of sandy loam and silt loam.

The Freneau loam in the aggregate is a type of considerable extent. It is an alluvial soil, developed in narrow stream bottoms. The material consists mainly of wash from Collington and Sassafras soils. The Freneau loam is developed mainly on the Delaware River slope of the principal divide of the area. It is naturally a poorly drained soil, much of it being saturated during the whole year. The type is all subject to overflow during flood stages of the streams.

The Freneau loam is not important agriculturally, on account of its poor drainage and its occurrence in narrow strips. The greater part of it is covered with underbrush, with scattered sycamore, gum, swamp maple, and willow trees. The few areas that have been drained are devoted chiefly to the production of the general farm crops, with canning tomatoes and potatoes grown to some extent. Most of the cleared land is used for pasturing dairy cows.

The type as a whole is probably best suited to use as pasture land, although where it permits of drainage good yields of the general farm and late truck crops can be produced.

#### RIVERWASH.

Riverwash is shown by means of the inclusion symbol on areas mapped in the Freneau loam color. Riverwash is the term applied to the river-deposited material occurring as a small island (Pettys Island) in the Delaware River, north of Camden. A border of Tidal marsh, too narrow to map, surrounds the island. Adjoining this is a strip of brown, coarse to medium textured sand, in many places thickly covered with gravel. The main part of the island consists of a fine or medium textured, dingy-brown sand, usually mottled with gray and yellow in the subsoil. The surface is covered with small depressions in which the surface soil for 2 to 10 inches consists of brown loam or mucky loam, underlain by the characteristic sand.

The vegetation in the hollows is a thick, rank growth of foxtail, burdock, ragweed, willow, aspen, and sycamore, while the sandy tracts have a scattered cover of sand grasses and weeds, and a sparse growth of bushes.

It does not seem likely that the Riverwash will be used for agriculture, although dikes have been built in places about the island.

#### TIDAL MARSH.

Tidal marsh comprises areas which are subject to daily tidal inundation. The soil material consists of dark-bluish or nearly black to mottled rusty-brown and drab silty clay loam to silty clay. In places it is very mucky.

Most of the Tidal marsh occurs along the Delaware River and its tributaries, the developments extending inland for several miles along such streams as Woodbury, Coopers, Big and Little Timber, Pensauken, and Rancocas Creeks. It is in general covered with marsh grasses and weeds, but along some of the streams willow trees are common.

In its natural state Tidal marsh can not be farmed. Some of the land has, however, been diked and put under cultivation, being devoted to corn, hay (timothy, redtop, and marsh grasses), oats, cabbage, and tomatoes. Some of the diked land is used for pasture. (See Pl. V, fig. 2.) Areas which have been diked are shown on the soil map by symbol as Reclaimed Tidal marsh.

All, or nearly all, the Tidal marsh can be converted into productive land, as has been done in a few instances. The cost of reclamation can be greatly lowered when all the farmers along at least one side of a stream cooperate in keeping up the dikes, the necessity for constructing lateral dikes thereby being avoided. After diking the land, drainage, by means of open ditches or tiles, is necessary.

#### SUMMARY.

The Camden area is situated in the west-central part of southern New Jersey, its northwest corner bordering the Delaware River opposite the city of Philadelphia. The area embraces parts of six counties and covers 702 square miles, or 449,280 acres. It comprises mainly level to gently rolling country, ranging in elevation from tide level to 214 feet above. Drainage is effected by numerous small streams. Those upon the Delaware River slope have well-defined channels, but the watercourses directly tributary to the Atlantic Ocean or Delaware Bay flow through depressions and numerous swamps.

The population is composed largely of descendants of the early settlers and other white persons of native birth, although in certain sections, as in the vicinity of Hammonton and Newfield, many are

of foreign birth, principally German, English, Italian, Irish, and Russian.

The system of agriculture in the Camden area consists mainly of trucking or trucking combined with general farming, while the production of fruits is important locally. The type of farming varies with the soil. On the heavier Sassafras and Collington soils the general farm crops are grown in conjunction with Irish potatoes and medium-late to late truck crops. On the Sassafras and Collington sandy loams orcharding and trucking predominate, and the Sassafras and Collington sands are used for early truck. In certain communities the growing of special crops is highly developed, as in the small-fruit district of Hammonton, the pepper district of Newfield and Malaga, and the fruit district of Glassboro and Moorestown.

Large quantities of stable manure and commercial fertilizers are used in the area. Liming and the growing of green-manure crops are necessary to the permanent improvement of the soils.

The Camden area lies in the Coastal Plain soil province, and the upland soils are derived from unconsolidated, ancient marine deposits. With the exception of the Freneau loam, an alluvial, stream-bottom soil, Riverwash, and Tidal marsh, the soils are upland types of Coastal Plain derivation, grouped in nine series, the Sassafras, Collington, Shrewsbury, Elkton, Keansburg, Lakewood, Hyde, Portsmouth, and Norfolk. The Sassafras and Collington soils cover the greater part of the area. The principal difference between these series is that the Collington soils have been influenced by glauconitic material, or greensand.

The Sassafras soils are in general well-drained, agriculturally important types, although the coarser textured members are droughty. The gravelly sandy loam is widely distributed throughout the area. It is highly esteemed for fruit growing. The coarse sand is an inextensive, unimportant soil, droughty and low in organic material. The Sassafras sand is extensively developed and about half its total area is under cultivation. The type is a desirable one for sweet potatoes and orchard and small fruits, as well as for early truck in general, although it is not of high natural productiveness. The loamy sand type is a little more productive than the sand. Practically all the area of the Sassafras fine sand is cultivated, being devoted mainly to early truck or sweet potatoes.

Of the Sassafras loams, the coarse sandy loam is a moderately productive soil. In the Malaga and Newfield districts peppers, cucumbers, and grapes are grown extensively on this type. The sandy loam covers a greater proportion of the Camden area than any other soil. About 60 per cent of the type is cultivated, being devoted to general farming and trucking. In certain sections dairying and orcharding are well developed. The imperfectly drained phase of

the sandy loam is unimportant on account of its small extent, but is largely cultivated. The fine sandy loam and loam are practically all under cultivation. The former is restricted in distribution to a belt a few miles wide extending across the area, but the loam is extensive and important agriculturally.

The Collington soils rank next to the Sassafras in importance. The Collington gravelly loam covers only a small total area, and about 90 per cent of the type remains in forest. The sand is an excessively drained soil, also largely remaining undeveloped. The Collington sandy loam and its deep phase are mainly under cultivation and are important soils agriculturally. General farming and trucking prevail. The fine sandy loam is the most important type in the northern half of the Camden area, and fully 90 per cent of the land is cultivated. The system of agriculture includes trucking, general farming, orcharding, and dairying. The Collington clay is largely undeveloped. The loam is an extensive type and is practically all farmed.

The Shrewsbury sandy loam is an important soil in the northern half of the area. The type is nearly all cleared, and where drained is used for trucking and general farming.

The Elkton loam is mapped in numerous small bodies. About half the land is cleared and part of this is drained and farmed.

The Keansburg loam is a rather important soil in the northern part of the area. It is used, however, mainly for pasture.

The Lakewood sand is an extensive soil in the east-central and southeastern parts of the area. The type is droughty and practically undeveloped.

The Hyde loamy sand also is extensive in the east-central and southeastern parts of the area. Many of the swampy tracts occupied by this type have been cleared and are devoted to the production of cranberries. With drainage the soil would apparently be desirable for late truck.

The Portsmouth sandy loam and loam are unimportant types agriculturally. They are used mainly as pasture, though with proper drainage and liming the land is well suited to the production of truck, and general farm crops do well.

The Norfolk fine sand is an inextensive soil, largely remaining sparsely forested. It is leachy and rather unproductive.

The Freneau loam is developed in first-bottom areas along streams. The type is subject to overflow and is mainly used for pasture.

Riverwash comprises coarse-textured deposits in the Delaware River channel, probably not suitable for agricultural use.

Tidal marsh is the term used to designate areas naturally subject to daily tidal inundation. Part of this land has been diked, and all, or nearly all, can be reclaimed for farming.



[PUBLIC RESOLUTION NO. 9.]

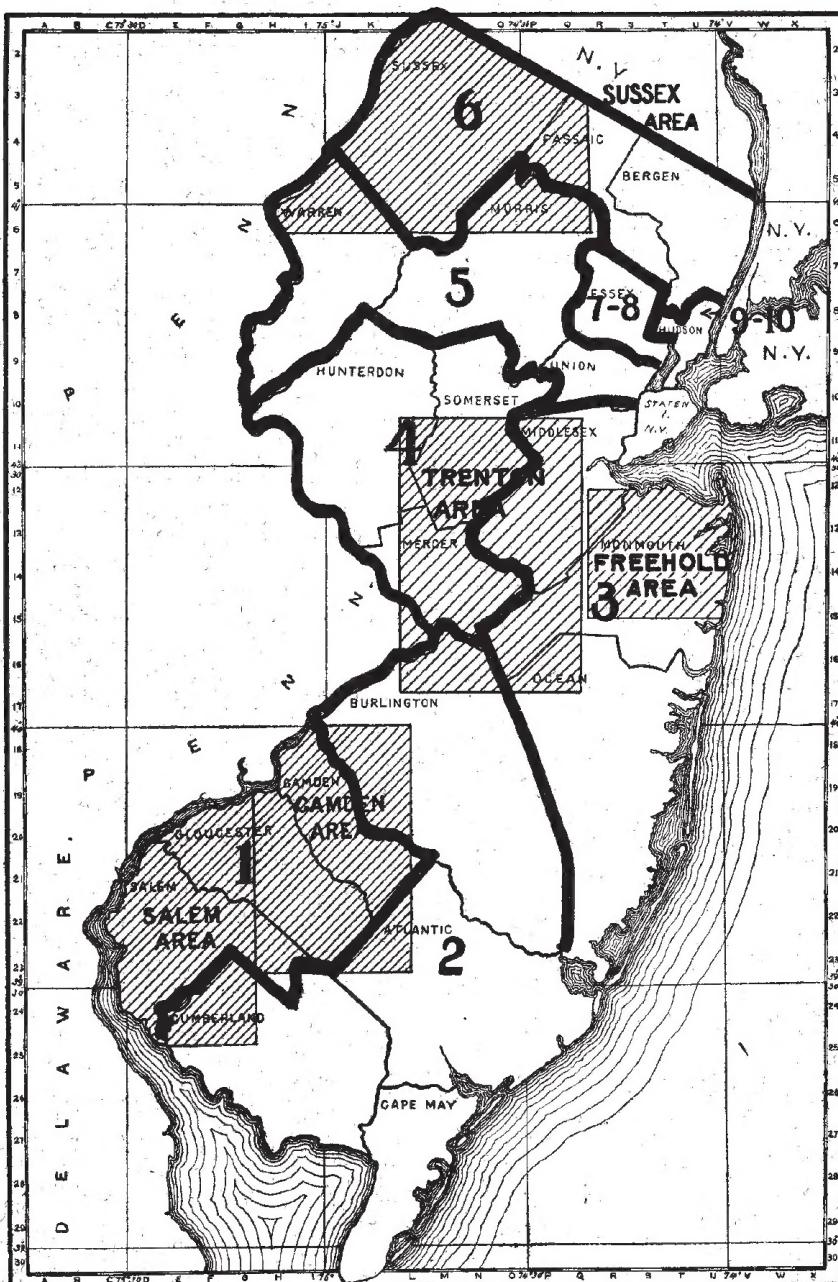
**JOINT RESOLUTION** Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on Field Operations of the Division of Soils, Department of Agriculture."

*Resolved by the Senate and House of Representatives of the United States of America in Congress assembled,* That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on Field Operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]



Areas surveyed in New Jersey.

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